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The Opening Address at the ATRS 2003 Conference, Toulouse, France

By

Professor Tae Hoon Oum,

President, Air Transport Research Society, and

UPS Foundation Chair in Transport and Logistics,

University of British Columbia, Canada

July 11, 2003

Distinguished guests, ladies and gentlemen! It gives me a great pleasure to welcome all of you to the ATRS World Conference being hosted jointly by Groupe ESC (Toulouse Business School) and the ENAC (Ecole Nationale de Aviation Civile).

Today and tomorrow, in addition to the Opening and the Closing Plenary sessions, 112 papers will be presented on virtually all aspects of air transport and related topics.

2003 is a particularly challenging year to air transport policy makers, aviation executives and researchers as most of the major network airlines are experiencing unprecedented level of financial difficulties in the 100-year history of aviation. But I am reminded of Mr. Georges Clemencau, the French Leader during the first World War. He said "our country advances ONLY through crisis and in tragedy". Likewise, I am confident to predict that air transport industry will also advance through these crises. Airlines are succeeding in restructuring their service networks, and streamlining their operations to an unprecedented level, and start to listen to what their customers and markets are telling them more closely. Most major network carriers in the United States and Canada have achieved a unit cost reduction of about 25% via their recent restructuring efforts. They will be coming out of these crises with resounding success in order to serve the rising demands for efficient and cost effective services. Now, I believe it is turn for the airports and air traffic control systems to do a restructuring comparable to what airlines have been doing in recent years. In this regard, I am particularly happy to see many papers and presentations in this conference are focusing the airports and air traffic control systems.

As a final note, on behalf of the ATRS, I would like to express sincere appreciation to Mr. Herve Passeron, Director of Groupe ESC-Toulouse, and Mr. Gérard Rozenknop, Director of the ENAC, and above all, Professor Sveinn Gudmundsson for their tremendous efforts to organize this conference so successfully. I also like to express our appreciation to AirBus Industries, City of Toulouse, Toulouse Chamber of Commerce, Aeroport Toulouse-Blagnac, and EQUIS for their active participation in this program and for their financial supports.

I look forward to a stimulating conference in the next couple of days.
Thank you very much.

The Air Transport Research Society (ATRS)
World Conference
July 10-12, 2003 Toulouse, France

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The ATRS held its World Conference in Toulouse, France, in July 2003.

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The yield of "migration"

'*Ethnic*' air transport as an overlooked customer segment

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Abstract

Following worker migration, mainly to Northern America and Western Europe, several cultural and ethnic communities live far away from their country of origin, they may still consider their home country. In order to stay connected with the wider family life in their country of origin, e.g. to take part in religious and other festive celebrations, these migrants need to return regularly. Since the geographical distance is rather important, air travel is mostly the preferred choice because of convenience. Nevertheless these customers are not necessarily specifically addressed by the airlines. This article focuses on the potential impact of airline marketing and service strategies for these ethnic groups. An explorative field study is used to assess research questions. The results indicate that ethnic transport customers show specific expectations in terms of marketing, ticket pricing and service for airline policies. Furthermore the generation changes start to impact this customer segment leading to alter the key issues.
Some suggestions for airline policies are made. Regardless of different views of customer orientation and corporate policy airlines are not sure to share a lucrative and growing market in the near future any longer, when certain key issues are not carefully addressed.

INTRODUCTION

Migration and "*ethnic*" travel

Since centuries the Western hemisphere (North America and Europe) is subject to waves of immigration from all over the world due to various reasons. Despite the political, social or economic motives of emigrants for leaving their country of origin, there have been many policies set up by industrialized countries to attract certain categories of migrant workers to settle with their immediate families. Immigration as well as worker migration ("guest workers") compensate the consistently low birth rates and increased longevity in virtually all industrialized countries of Northern America and Western Europe, which will even need larger waves of immigrants just to keep their current ratio of workers to retirees.

Following such worker migration, several cultural and ethnic communities live far away from their country of origin they may still consider their home country. Even for immigrants who intend to remain in the host country and eventually take the host country's nationality, the links with the culture and the country of origin may still be important.

In order to stay connected with the wider cultural and family life in their country of origin, e.g. to take part in religious and other festive celebrations, these migrants wish and need to return regularly. Since the geographical distance is rather important, air travel is mostly the preferred choice because of convenience. This forged a cyclical as well as seasonal movement of migrants between the country of residence and their respective countries of origin labeled as "ethnic" travel.

Historically the "ethnic" traffic was developed after former colonies became independent, for example with the creation of special fares reserved to migrant workers from the Maghreb

countries (Algeria, Morocco and Tunisia) living in France. Later, those special fares converted to "resident" fares (Héguy, 2002: 33). These fares are often priced with less than 40 % to the standard fare and linked to certain advantageous conditions like a longer validity with three months instead of the normal one, possible modifications of the ticket without penalty and also a higher luggage allowance of 30 kg.

In France, initially those tickets were only distributed through certain selected agencies of the national flag carriers of the migrants' home countries or a few other specialized agencies, therefore not necessarily easily available across the whole country. All resident migrants who wished were not always able to obtain these special tickets because of certain quotas as well as a distribution system that was mostly organized and only available in important migrant residence areas, e.g. certain suburban areas of Paris. In addition and despite the comfortable return on ethnic travel fares for the national flag carriers, these customers are not necessarily specifically addressed by the airlines. With deregulation, privatization as well as the overall increased competition by private airlines, this market seems to loose its exclusivity for the (former) national flag carriers and the specialized agencies. With the example of Portugal as a member of the European Union (EU), those special resident fares had to be abandoned since they were inhibiting the free movement of people as one of the four principles of the EU Single Market. The introduction of yield management put pressure on fares that were, in the past, regarded as special for migrant residents compared to the full standard fare, nevertheless still providing a high return for the airline.

The erosion of margins and change of the market raise questions for the concerned airlines, particularly from the marketing and service point of view. That means for the airline marketing to work on communication, e.g. specific advertising as well as sponsorship of "ethnic" events with public visibility among potential clients. A desired service constitutes the pre-assignments of

seats for families traveling together instantly upon their reservation. The national flag carriers are definitely concerned since they may loose profitable business, as are those private airlines who have discovered this market providing at least high load factors during certain periods of the year.

One particularity of ethnic travel is its ***periodicity***, most of the demand occurs mainly once during the summer vacation, when migrant workers return to their countries of origin for the annual family meeting. The major share of the ethnic travel business is realized during the summer vacation as well as for Christmas and Easter and has shown continuous growth without the downturn following recent crises for business of leisure air travel. The market of ethnic travel therefore seems to be ***less sensitive to international crises*** compared to other business and leisure travel.

Another particularity concerns the need for ***flexible tickets*** by these customers, very often requested with an open return, since they do not know exactly in advance when they can travel and return, mostly due to family reasons as well as work considerations. Such flexibility has justified high fares and therefore a higher profit opportunity for the airline.

The clients also show a general tendency to ***high loyalty*** and habits to deal with the same travel agent or national flag carrier agency for years to obtain their tickets. This is very often due to traditional behavior dealing with a personally known vendor of the national flag carrier or a specialized agent, as most business is done by phone or face-to-face.

Nevertheless, the customer becomes more price conscious and with the emergence of private competition, as well as charter and low cost carriers, the initial, relatively high fares for this customer segment are under great pressure.

Generation change

Another pressure on this customer segment comes from generation change of immigrant residents who have lived for a long time in the industrialized host countries. Migrants of the first generation tend to keep very close ties with their wider family and friends who remained in their country of origin, and the above-mentioned particular features apply. Since the different waves of immigration after World War II to Western Europe and France have settled since more than a generation and finally established their center of life in the host country, the question is raised how generation change will impact on ethnic travel. Does the second and third generation of immigrants still exhibit similar needs compared to the initial ethnic travel features with periodical and flexible travel requirements? Do they continue to show loyalty to the national flag carriers and specialized agencies to obtain their tickets or is the growing competition easily entering into this customer segment?

Is the business still dealt with over the phone and face-to-face or is the Internet with e-marketing and e-ticketing a media with increased acceptance? This is definitely a decisive shift for upcoming generations that are used to computers, since selling over the Internet and e-ticketing also provides very often interesting bargains with cheaper prices for air travel tickets since airlines save on agency services.

In summary this leads to two important questions from the airline's point of view:

1. Is there and what is the best way to deal with ethnic travel customers?
2. Can one of the highest yields of this particular market be maintained in the future?

Our research questions address two main issues for consideration by airlines since it is important to know what do these customers want (Holden, 1997) and how to improve the business to a win-win situation where both sides, the customer and the airline, perceive a fair benefit out of the transaction.

In the following sections we detail the methods applied for the empirical field study and data collection leading to first results for the sample of migrants traveling from and back to France. We then discuss the implications of the findings for future research and practice.

METHODS

Research design

In order to answer our research questions we chose to obtain data throughout field case studies of airlines that are significantly concerned by an important market of ethnic travel.

Our study is still on an explorative level and we chose the country of France as a start and first sample area, where a considerable amount of migrants from other European countries as well as Africa have chosen to live and work since several generations. With regards to the structure of immigration to France, with particularly large numbers coming from Portugal as well as Northern Africa, we underline that the historical colonial links of the latter countries with France enhance the movement of migration until today. Only three nationalities (Portuguese, Algerians and Moroccans) combine close to 50 % of all foreigners living in France (INSEE, 2003; see Table 1). This figure may be even bigger with regards to the country of origin of all French inhabitants. Since are not accounted for in these figures the residents who have chosen to obtain the nationality of the host country through naturalization and who are therefore no longer shown in the demographic statistics of the non-French nationals.

Table 1 :

FRANCE – Demographic data

Foreigners with selected nationalities according to the last national census

	1999 in '000	in %
Total Population of France	58 513,7	-
of which		
Total foreign population	3 258,5	100
Total Europeans	1 333,3	40,9
of which		
Portuguese	555,4	17,0
Italians	200,6	6,2
Spanish	160,2	4,9
Total Africans	1 417,8	43,5
of which		
Moroccans	506,3	15,5
Algerians	475,2	14,6
Tunisians	153,6	4,7

source: Tableau B.03-1, INSEE (2003)

Research instruments

To start our field study, we conducted interviews and field observations with managers of airlines facing this type of "ethnic" transport requests as well as with users and potential clients for such transport offer. The interviews where either dealt with face-to-face or over the phone and followed a semi-directive approach in order to explore and find out about the issues of ethnic travel with a first focus on France.

Sample

The airlines included in our study are mostly national flag carriers since the privatization is rather slow in the countries of Northern Africa. Only Algeria has seen the emergence of a private rival carrier Khalifa Airways confronting the national airline Algeria Airways so far on certain standard flight connections, otherwise there are national charter companies set up more in complementation to the national flag carrier like Morocco Airways and Nouvel Air Tunisie. Nevertheless, there are other regional and international airlines that serve certain destinations of ethnic travel with regular scheduled flights, therefore adding to the competition on certain routes with the (formerly exclusive) national flag carriers of the country of origin, like, e.g. Mondair and Air Atlas Express (both Moroccan) operating to Maghreb destinations, mainly from and to Paris. (Other examples: Air France: Paris-Casablanca; Air Litoral: Montpellier-Casablanca; TAP Air Portugal for Portuguese destinations; Air France/Delta Airlines and American Airlines: Paris-Miami/Point-à-Pitre - Port-au-Prince as well as Air Canada with Paris-Montreal- Port-au-Prince for the Haitian community.)

Our corporate interviewees hold positions of Marketing Director and Vice President and represent their respective companies in France. Through the corporate interviewees we also got access to clients with particular emphasis to the segment of ethnic travel requests.

Measures

Through the interviews with marketing representatives as well as customers we wanted to know whether there is still reason for offering ethnic travel fares and services and about eventual generation change of second and third generation immigrants and their present expectations upon airlines compared to the initial ethnic travel features with periodical and flexible travel requirements. From the airline point of view the generation change was mainly measured by age

group estimation of customers booking their tickets. A second question for inquiry concerned the customer loyalty to the national flag carriers and specialized agencies to obtain the tickets as well as the status of growing competition from other airlines. A third part of our inquiry went into the media means customers prefer to use, either by personal face-to face contact in an airline or travel agency, over the telephone or electronically via the Internet.

In addition to the field interviews, we conducted participant observation and research on documents eventually made available by the airlines. With regards to the highly competitive environment, the airlines are unfortunately very reluctant to disclose more precise statistics on the business with amount and yields of ethnic traffic, since they consider this information as very strategic.

RESULTS AND ANALYSIS OF FIELD STUDY

Explorative study

The results of our explorative field study for France indicate that ethnic transport customers show specific expectations in terms of marketing, ticket pricing and service for airline policies. Furthermore the generation changes start to impact this customer segment leading to alter the key issues.

We identified five mayor criteria that appear to be important to ethnic travel customers and influence their choice of the airline and the travel agent:

1. **Price**; the clients expect this price to be only slightly above the latest fixed date and non-changeable travel ticket (APEX). With the increased use of Internet particularly by the

younger generation, customers have a more informed overview about ticket pricing among competing airlines for selected destinations. Communication and associated marketing make improved service better visible to clients in order to justify higher fares.

2. **Flexibility** of travel with an open return and possible changes of the ticket at any time (if possible without penalty or increased fare) is very important to ethnic travel customers as well as longer validity dates for the return with more than a month. These provisions are more difficult to provide for a low fare since the requested flexibility has its price.
3. A more important **luggage allowance** included in the ticket price, as ethnic travelers go for a long (annual) vacation to their home countries and have to bring a considerable amount of gifts for the larger family and friends.
4. Direct **point-to-point service** to desired destinations versus the hub and spoke system. Customers do not wish to spend a lot of time traveling with multiple connections, since they want to benefit the most out of their vacation time with their loved ones in the country of origin.
5. Other **service expectations** like the pre-assignment of seats for the whole family traveling together upon booking. This also helps a very smooth processing of all passengers at check-in and limits last-minute trouble for changing seats by the ground staff.

With regards to the increased competition from other airlines that sell available seats to ethnic travel destinations at very competitive prices, it is crucial to know what the customer really wants for attracting and retaining the ethnic traveler.

Ethnic transport is relatively insensitive to crises affecting international air travel in the business and leisure segments, therefore is represents a customer segment with more stable returns sustaining the high interest for airlines. To support this argument, we used the travel statistics of

airlines and airports looking at the amount of ethnic travel passengers as measurement for certain destinations. We compared the amount of travel for those selected ethnic travel destinations before and after September 11th 2001 as well as during the crisis in Iraq and did not find a significant decrease of passengers after those events. This confirms that ethnic transport is definitely crisis resistant compared to other business or leisure travel, since the ethnic passengers do not postpone their family travel.

Customers of Maghreb origin also show loyalty to the airline local office or travel agency, where they used to buy their tickets; therefore private competition has a harder stand and seemed to be less fierce. Nevertheless, this is changing with the new, younger generations and increased use of the Internet, notably because price is an important issue. Particularly the younger customers will shop for the best price and use the comparative Internet-based travel services for obtaining best bargains. Travel agencies who offer tourism travel packages with airfare, hotel and car hire, etc. combined, normally only available for tourists, also offer exceeding seats with very cheap fares on charter flights for citizens with the nationality of the destination country completing their loads. This occurs despite the problematic issue of lower landing fees and taxes for chartered tourism, initially destined to non-nationals of the destination country, adding to the rivalry of regular and charter airlines as well as travel agents chartering planes of a regular carrier. On top of possible derogation by the civil aviation authorities of the destination country, this concern becomes less and less a problem since more migrants acquire the citizenship of their host country and therefore are able to display the different passport needed to count them as "tourist" to the destination country entitled to benefit from cheaper charter flight fares. These bi-national migrants are therefore more and more able to pick the best fares between regular Apex and charter flights for the desired destinations. Notwithstanding, this alters the former client loyalty

and put pressure on competition, since very cheap fares were initially not part of the ethnic travel contingent.

Despite the still most important amount of ethnic travel business that is dealt with by phone, another impact for change is the increasing use of electronic means to get information and to book and buy airfares over the Internet not only for cheaper fares, but also as a fast and convenient way. If, in the past, the social interaction with the personal travel agent or airline representative was important and linked to maintaining customer loyalty, today it is more the competitive pricing and frequency to a choice of destinations that creates (not only) ethnic travel business. Nevertheless, the ethnic travel market for the Maghreb has no e-ticketing yet; so far mainly reserved for regular business passengers on the concerned destinations.

70 % of all ethnic travelers are in the age group 35-65 years, mainly representing the experienced migrant working population; the other 30 % comprise the younger generation and the major share of accompanying children.

Since the ethnic traffic is a cyclical as well as seasonal movement of migrants between the country of residence and their respective countries of origin, mainly during the three months of summer (25-30% of the business is realized during this period), this puts more stress on regular carriers with regards to their capacities as well as landing fees and taxes compared to charter companies, who can "pick the sultanas" of the high peak of traffic during specified periods.

Also because of the periodical, but not very frequent travel needs of the ethnic traveler, who goes on the plane for this type of travel mostly once a year, present frequent flyer programs offered by airlines are of no interest. The amount of travel per individual will never be sufficient to obtain any benefit out of such a program.

With regards to the ticket reservation and purchase of tickets and communication channel use, the phone is definitely the mean used by 98% of all customers, despite some students and a few other young people using the Internet for getting information, but who are not necessarily buying over this channel (this represents only about 2 % of ethnic travel sales). Concerning the distribution network, the major share of sales is dealt with through affiliated travel agents to the airlines (70-75%), higher in Paris than elsewhere in France because of a strong independent agency network, and less than a third directly through the airline representative offices (25-30%), more important for non-Parisian sales.

Most ethnic clients reserve over the phone and pick up the ticket at the agency before they travel, very few tickets are either send by postal mail or made directly available to the customer at the airport the day of travel. This latter service represents definitely a client-friendly opportunity particularly for migrants who do not live very close to a travel agency or airline representative office.

Discussion

The market of the airline industry is generally divided into two segments, the business traveler and the leisure traveler. Nevertheless, some airlines have to consider the ethnic traveler as a third category giving way for a tri-partite segmentation. This stems mainly from national flag carriers of emigrant countries and certain colonial patterns. Interestingly is occurs that this ethnic segmentation was initially not proactively developed by the airlines, but resulted out of the demand of the customers. Finally, the air carriers did not at all anticipate this travel flow but have been followers of a self-emerging market!

We observe indeed that ethnic air transport concerns a particular segment of airline customers who have specific expectations towards the carrier or travel agent for their transport needs still

providing a high yield to the service provider. Airline marketing and service strategies should therefore answer the question of how to address these customers with regards to maintaining an interesting yield as well as a future market itself.

Speaking the language of the customer was definitely an issue for migrants, who did not necessarily have learnt the language of the host country (house wives, grandparents...), but will be out leveled by the upcoming generations, who tend to be better integrated into the host country, also from a linguistic point of view.

Furthermore the generation changes start to impact this customer segment leading to alter the key issues. With regards to the importance of price and keeping in mind that the fare represents still an important budget for the ethnic traveler, clients tend to show more and more hopping behavior for the best fare changing their agent easily. This means a significant downturn in customer loyalty, particularly for the national flag carriers. In addition, the ethnic travel fare will only survive when the customer and the airline perceive a fair benefit out of the transaction.

The upcoming generations of former immigrants, who settled in the industrialized countries, live now much better integrated than their parents and grandparents in the host country. Very often, they even chose to adopt the nationality of the host country and get naturalized. This puts another threat to the segment of ethnic travel: Since they do no longer have the strong ties like their ancestors to the initial country of origin, it means that ethnic travel seems to have no bright future. Furthermore, immigrants from the more senior generations mostly stemmed from more rural areas, where employment as well as economic development was scarce and made often the reasons for leaving their country of birth. However, the present young migrants or children of migrants have no longer the desire to return to the countryside, often regarded as lagging behind areas, during their annual vacation, despite existing wider family ties. With the generation change

we observe an altering travel behavior where people go back to the countries of their parents or grandparents mainly for very special occasions (weddings, etc.) but no longer for the annual family vacation.

Ethnic transport has the strong preference for travel date flexibility, particularly with regards to the return and mostly because of family reasons. As a consequence, the ethnic traveler prefers to purchase a ticket with an open return to avoid ticket changes that may incur penalties and/or increased fares. Since Apex tickets have fixed travel dates and are non-refundable, they are not always preferred despite the importance of price for the ethnic traveler, since the return dates has to be irrevocably fixed upon booking.

The luggage allowance is another critical factor where ethnic travelers have specific expectations. The mostly European system with a weight limit per passenger of 20-25 kg but no piece restriction stands in front of the American system where airlines generally allow two pieces of luggage with a maximum weight up to 55 lbs each. This is close to the double allowed by European airlines and the ethnic traveler may need even more. Southern Europe and Northern Africa as the countries on both sides of the Mediterranean have a culture of sharing in common, which explains the large amount of gifts brought back to the home country by the ethnic traveler and the definite need for higher luggage allowances!

Another critical factor concerns the service frequencies and destinations offered by the airline for the ethnic traveler. This schedule convenience may attract or divert ethnic clients from the choice of a specific carrier, if the competition has a better point-to-point offer. It appears that the importance of direct destination service may lead to new entrants into markets initially served by

the national flag carriers with a hub-and-spoke or connecting travel route only (e.g.: Paris-Fes directly instead of Paris-Casablanca-Fes). Charter, regional or low cost airlines can obtain a substantial share of the market with such direct point-to-point offer and are able of "sultana picking" with offering service on high yield routes only compared to national flag carriers who serve a wider network. The domestic network and schedule convenience of these national carriers is another argument for the ethnic traveler to board a connecting flight or to prefer a direct point-to-point eventually offered by a different carrier. This fosters the well thought organization of domestic connections in the countries of origin of the ethnic passenger as an issue of the hub-and-spoke system in general.

Since the ethnic travel market has no e-ticketing yet because it seems having cultural difficulties to get accepted by customers of this category so far, other requested service examples include the availability of the ticket at the airport the day of departure for customers who live in more rural areas of France away from the travel agencies or airline representative offices. This avoids unnecessary commuting of clients to obtain their ticket before the day of travel.

With regards to frequent flyer programs for the ethnic traveler, we could imagine the possible grouping of frequent flyer points and miles for one individual cumulating the advantages of the whole family in order to get at least one possible advantage in the framework of a frequent flyer program. This is also a very strategic question for the airline, keeping in mind that most frequent flyer schemes are loss-makers for the companies (see: Chin, 2002; Kearney, 1989; Whyte, 2002). It will be interesting to see what will be the position adopted by airlines with regards to the ethnic travel segment, notably the (former) flag carriers as well as other private, charter, and low cost competitors.

Limitations and Future Directions for research and practice

Our study emerged from a practical business problem and perspective with a specific concern faced by many airlines concerned by ethnic traffic. We tried to answer the questions of what is the best way to deal with the ethnic travel customers and whether the high yields of this market can be maintained in the future. To find answers to our research questions we decided to start the exploration in France as a country with a particular history of migration due to the colonial past as well as the present migration features.

We wanted to illustrate the weight and opportunities of ethnic travel for certain carriers and areas of Europe as well as the world, nevertheless not very often distinguished as a segment requesting specific management efforts despite its high yield. First results of our interviews and observations are still on an explorative level.

With regards to the fierce competition for the airline customer we were not always able to access more precise quantitative data from the different airlines in order to standardize and make them comparable. Furthermore, additional and more quantitative data over a longer time frame is needed to display the evolution of ethnic air travel. Future research could also compare migration flows in different parts of the world and identify whether there is a similar pattern for all ethnic travel or differences according to particular groups of migrants as well as their countries of residence.

Regarding generation change and the future of ethnic transport the question can be raised about the country migrants coming upon retirement age and will live and enjoy their pension. Do they either return to their country of origin or will they finally settle and integrate the country of residence after their working life? Where will their children live, study and work? We see

interesting scenarios for the future of ethnic traffic with regards to volume, destinations and range.

CONCLUSION

With regards to our explorative study, it seems that ethnic air transport is an often overlooked customer segment without particular consideration for marketing policies to be adapted to a distinguished target group of passengers.

Our suggestions for airline policies concern the review of marketing and service for this specific customer segment of ethnic travelers, because, looking at certain migration flows, it represents a significant business with a high yield for airlines. The concerned airlines should therefore take into account the specific expectations and needs of these ethnic travel passengers as well as the possible evolution of this segment. Airlines could take a more proactive stance for the ethnic customer segment with more adapted marketing and management lead by a customer driven strategy. The ethnic traveler expects to be treated as a special category of passenger, notably in terms of pricing, flexibility, destination choice and schedule convenience, luggage allowance and other services. Otherwise airlines will not benefit from and keep the high yields this market provides at present and may do in the future. This means revising the former bi-partite segmentation and marketing strategy for business and leisure to give way to a tri-partite segmentation including the ethnic travelers and also offering those an adapted marketing mix.

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Simulated Consumer Decisions: An Application of Synthetically Generated Consumer Profiles

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Abstract

This presentation offers a methodology for the construction of a simulation of consumer decisions within the context of the air-travel market. The simulation's primary strength is in the provision of individually structured decision making possibilities across many consumers. The methodology enables the synthetic generation of a profile for each individual consumer thereby providing a rich and adaptive consumer base from which to generate a market. By this method the calculated utility of a product in the market can be shown to be different per individual decision-maker. The methodology is well grounded but commercially successful application depends on the efficacy of the available data.

KEYWORDS: Microsimulation, travel demand.

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1. Introduction

The analysis and forecasting of air-travel demand is a key component of the revenue maximisation methodologies used by most of the airlines in the world today. Understanding the nature of the demand on the routes that an airline services allows the airline to set fares and capacity in line with the airline's expectations on those routes. While the understanding of air-travel demand has traditionally relied on econometric modelling based on historical data, this paper suggests an alternative approach. That approach is to simulate consumers in an air-travel market and their interactions with the choice set presented when they seek to travel on a particular route.

Critically, this paper should be considered as work in progress since the methodology suggested is still at an early stage of development. The key outcomes of this paper are the presentation of a suggested methodology for microsimulation of consumers in the air-travel market and recognition of the key obstacles in the development of such a simulation. As will be seen, the most notable obstacle, as in many other applied approaches, is in the efficacy of the data that is used in the simulation.

An air-travel market is particularly well suited to a simulation approach because of the wealth of information that is held by airlines and because of the differentiated consumer types that exist within the market. Traditional approaches have focused on estimating models of demand and using those models as a basis for forecasts. The simulation approach, on the other hand, constructs a model of consumer interactions with the product based on real world data. This approach produces a higher degree of flexibility in the response of the consumer to changes in the choices and the attributes of those choices.

The upcoming section of this paper provides a background on consumers in the air-travel market and the nature of their choice decisions. This is followed by an outline of the suggested methodology for the creation of a simulation of a market such as the air-travel market. The fourth section identifies the data requirements for a commercially successful

run of the simulator while the final section presents the conclusions and outlines our direction of research.

2. Background

The approach of simulating the demand for air-travel across many consumers has the key benefit of allowing a closer examination of a sub-set's behaviour from within the overall population base. In an industry where price discrimination between consumers has been a central element of revenue maximisation strategies, a clearer picture of the behaviour of these different sub-sets and even individuals within those sub-sets can be considered quite useful (see Gale and Holmes, 1993, and Belobaba and Weatherford, 1996 for analyses of the role of price discrimination in revenue maximisation strategies).

Airlines normally discriminate between at least two types of consumers – the leisure traveller and the business traveller. By setting high prices with high flexibility, airlines have normally been able to proficiently target the business consumer, while setting lower prices and reducing the flexibility (through, for instance, stay requirements or in-advance purchase requirements) has been an effective approach for targeting the leisure consumer. Although there is a range of other consumer types (retirement travel, student travel, etc) and other ticket types, the key underlying point is that the airline recognises the different consumer types and attempts to maximise its revenue through specific targeting.

A more detailed understanding of the value of the microsimulation approach with synthesised consumers can be gained through initially evaluating the choice decision and utility function of the air-travel consumer. A consumer (n) in the air-travel market will normally face a choice set (C_n) that contains each of the travel alternatives and choose that alternative (i) that maximises their utility (U):

$$P(i \mid C_n) = \Pr(U_{in} \geq U_{jn}), \forall j \in C_n \qquad \text{Equation 1}$$

By expanding the utility functions such that the problem becomes a random utility model (with error ε) and including the attributes of the tickets (x), price (p) and the budget constraint (m) explicitly, the following utility function is presented for a particular consumer[1] n.

$$P(i \mid C_n) = \Pr\left[U(x_{in}, m - p_{in}, \varepsilon_{in}) = \max_{j=1\ldots k} U(x_{jn}, m - p_{jn}, \varepsilon_{jn})\right], \quad \forall j \in C_n \qquad \text{Equation 2}$$

A consumer will choose the alternative from the choice set that maximises their utility and will be observed to do so probabilistically. While the model can be expanded to include a number of other complexities, for the purposes of this exposition, the simplicity of this model is useful enough[2]. In the event that detailed information on the consumer and their tastes is available, it is possible to assess the likelihood of a particular choice being made. Normally, the information to hand is of a more aggregate level where an assessment might be made at the consumer sub-set level or, more likely, at the population level. This usually means that the discrete choice model is aggregated such that a representative consumer is used to evaluate the choice.

Anderson, de Palma, and Thisse (1996) provide a useful explanation of the aggregation of consumer choice. The utility function is modified slightly for alternative i in a consumer's choice-set to:

$$U_i = m - p_i + x_i + e_i \qquad \text{Equation 3}$$

Here, instead of using ε, e is used. In this case, the subtle but important difference is that e is used to describe the valuation that that particular consumer places on the alternative i and consequently move from a random utility function to a deterministic utility function.

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[1] For further elaboration on the random utility model and discrete choice theory, see Ben-Akiva and Lerman (1985) or Anderson, de Palma and Thisse (1996). Domencich and McFadden (1975) also serves as a useful reference on probabilistic choice theory in a travel demand setting.

[2] Battersby (2002) examines the nature of the capacity constraint in the consumer's choice and incorporates a further level of probability that accounts for the probability of ticket availability.

Each consumer will hold a set of valuations, $e_1 \ldots e_n$, across the entire choice set, C_n.[3] In the population of consumers, the valuations of the population are distributed over $\mathbf{R}^n$ according to the density function:

$$g(\underline{e}) \equiv Nf(\underline{e}) \qquad \text{Equation 4}$$

such that:

$$\int_{\mathbf{R}^n} g(\underline{e})d\underline{e} = N \qquad \text{Equation 5}$$

The market segment of i then, is:

$$S_i \equiv \left\{e \in \mathbf{R}^n; U_i(\underline{e}) \geq U_j(\underline{e}), \forall j \in C_n, j \neq i\right\} \qquad \text{Equation 6}$$

It is at this market segment level that standard approaches normally provide a model of demand. The distribution of the market segment is known and it may be apparent that a particular consumer falls within a particular market segment. The determinism associated with equation 3, however, is not known and the consumer behaviour is inferred from the less precise distribution of the market segment being evaluated.

The critical advantage of the microsimulation approach, then, is that it allows the analyst to synthetically construct deterministic choice probabilities. By constructing the consumer base from the bottom up so that synthetic individual deterministic consumer utilities are known, the distribution of equation 6 can be narrowed to the observation of an individual consumer if it so desired. The analyst can then evaluate, to the level of the synthetic individual consumer, the nature of the choice that is made in the simulation.

[3] It is also possible that the set of valuations may determine a consumer type if there is more than one consumer that holds the same set of valuations.

3. Methodology for the development of a simulated air-travel market

Information systems in general require a formal specification to enable the translation of logical and mathematical constructs to functional applications. This methodology is the outcome of analysis work performed to enable a viable implementation of the concepts discussed in a computer-based simulation. Only domain concepts (those relating to a logical solution to any recognised problem) are discussed here. System architecture concerns, while highly relevant to any implementation, are disregarded in this discussion.

The overarching goal of this simulation is flexibility. The ultimate outcome of the development of the simulation technique will be built on the requirements of:

1. A strong and useful binding with the established econometric science,
2. The clean and non-biased subsumption of real-world data and observations, and
3. An incremental, continuous refinement and extension of the economic models.

This paper focuses on three core elements of these requirements. They are:

1. The event-utility dichotomy,
2. Discretionary attributes of the products or choice alternatives, and
3. The synthesising of individual consumers.

3.1 The event-utility dichotomy

The first key concept that facilitates much of the analytical work is what the system internally recognises as the event-utility dichotomy. Utility is used in the economic sense such that a consumer will always make the decision that maximises their expected utility. The simulation is therefore able to state categorically that for any decision that it generates, the utility is maximised. Conversely, this enables the analyst to make the observation that, "in any case, all you need to do is to calculate the expected utility for all

possible decisions, and then the consumer will pick the one with the highest result for their individual utility function."

While this is logical reasoning, to calculate the expected utility for all possible decisions raises some problems in practice. Chief among these is the omniscience required to truly know what an individual consumer's utility function is. Also problematic is acquiring the knowledge of what all possible decisions may be. The simulation adopts the approach that for any given possible transaction, the origin, or zero point, is specified as "do nothing", that is do not buy, sell, investigate, or otherwise participate in the market. For the vast majority of possible pairings of consumers to products at any particular time, the calculated utility is then presumed to be negative and the consumer will "do nothing" in the market for that product at that time.

The simulation, then, changes the nature of the statement such that "a consumer will decide between all viable decisions so as to maximise their utility". This is substantially different from the statement, "a consumer will decide between investigated decisions so as to maximise their utility" which may be untrue; a consumer may well investigate and increase their market information as part of the transaction cost. So, to identify those situations where any decision other than "do nothing" might occur, the simulation refers to these periods as "events". The consumer may elect to "do nothing" in response to an event, but the simulation does not calculate the consumer's aggregate responses to "non-events". The onus is then on the analyst to decide what may constitute an event. In this case, they are:

1. The need or opportunity to travel is suddenly realised by the consumer.
2. Travel product awareness, via either advertising or osmosis, is learnt.

To establish a watershed, a consumer discovering a need to visit a destination to which the loss in their expected utility may be reduced by flying is an event of the first type. A consumer learning of a discount rail ticket to a destination that they would normally have chosen to fly to is an event of the second type.

3.2 Discretionary attributes

The second key concept is that of discretionary attributes. The system does not attempt to model all possible distinguishing features of every simulated entity in advance. Instead, the core concepts of entity, relationship and attribute are established. Two entities may be connected via a relationship, and attributes are applied to entities and relationships. In this manner some requisite flexibility is gained.

These core concepts are identified using an object modelling approach, but more correctly describe a meta-model rather than a single logical model. They are chosen to minimise complexity while providing full coverage of useful implementation concepts. Note that the meta-model at this point is quite similar to the representation of data in a typical relational database.

An entity is then further subdivided into person and organisation to distinguish between those decision-makers who are individuals and those who are legal entities with formal management processes that may affect a large number of people. Typical and therefore universal attributes of established organisations are turnover and profit. For a simulated person their total income is also always measured, and their home address is always known.

To cope with an increasingly less rigid workforce, jobs and other employment types are modelled via the relationships of the person entity to their employers or clients. This allows a more accurate representation of a person's role as a producer in the economy and also provides valuable inferred data about the flexibility of their attendance at company premises, for example.

This flexibility provides the facility to expand the simulation's access to real-world data easily. It also allows the system to address new economic concepts when required, without reworking functioning simulated systems. However, it can create difficulties in

establishing utility functions where attributes may apply to one entity and not another. For this reason any component of the utility function is expected to still approximate the population's mean if all components utilising unknown attributes are taken to equal zero in quantitative contexts. This merely requires careful assembly of new utility function components.

Attributes may be either real numbers or text. In the case of text components, a vocabulary is constructed and extended when necessary. This enables the descriptive segmentation of the consumer base by their pre-established identification with a particular sub-set. Note that some of these attributes may be derived from others for simpler use.

3.3 Synthetic Consumers

The third key concept is that of synthetic consumers. The simulation is equipped to model information derived entirely from real-world data, but this is not feasible over a lengthy period, nor is the data always available to precisely model every desired attribute as surveyed or observed. The system aims to provide precise results to economic stimuli and not accurate consumer profiles for simulated areas. Thus, the consumers can be entirely fictional and the simulation is still intended to produce 'real' results.

This enables the simulation to provide feedback about existing economic systems in both its construction and execution phases. Indeed, establishing which relationships and attributes are crucial to observe similar results in the simulated system can provide valuable, albeit qualitative, information to the analyst constructing the simulation.
It must be stressed that although the simulated entities, relationships and attributes may be entirely fabricated, they should always be derived from relevant statistical information available if a commercial outcome is sought. It is then only a question at which level of aggregation the simulation's data matches the real world data. It is also vitally important that analysts constructing the simulation are equipped to refine the fabrication mechanisms to produce statistically valid results for a comprehensive testing regime. It is

perfectly accurate to view this approach as concurrent testing and construction ad infinitum.

The strength of the simulation is in its capacity to quantitatively describe the reasons for any particular decision made by a consumer. The individual utility function for any purchase is accessible, and complex 'what-if?' scenarios are relatively easy to create. This is one immediate benefit of modelling each consumer decision individually. Another valuable benefit of this methodology is that the simulation can provide better insights into structural changes in a community. Traditional econometric methods are perhaps better equipped to assess precisely the interdependence of variables, but this ability to fabricate a core mechanism - the individual utility function - provides a deeper and richer consumer base. Each consumer will act independently of their aggregated origin, and behave as one would expect them to behave.

Adopting these three concepts - the event-utility dichotomy, discretionary attributes, and synthetic consumers – enables a strength of microsimulation that may reward the investment in such a deep structure. The targeted areas in which this simulation aims to provide results that are demonstrably an improvement over traditional econometric models are small, but high-yield areas for modern airlines. Primary among these is a powerful model of how market information affects any individual's perceived utility for any product.

The most problematic of the simulation's weaknesses is its dependence on comprehensive information. Aside from the usual difficulties encountered with synthesis, the simulation is demonstrably dependent on a high degree of accuracy in household distribution of income and assets, the nature of work, and the distribution of market information. Although these are common concerns to most analytical methods that predict consumer behaviour, in this case the simulation may not be just quantitatively but structurally inconsistent in modelling the utility mechanisms for an individual.

4. Data requirements for a commercial application of the simulator

To develop commercial simulations of this nature, information is desired that is not only disaggregated for any particular attribute of the individual, but also *correlated* in regard to these attributes. For instance, information regarding household income is readily available and, should this be the only attribute of interest, sufficiently disaggregated for construction of synthetic income earners. The same may be true of the industry of employment for individuals by age category. But the information in regard to both these attributes is not normally correlated; there is no way to estimate what the mean income for retail workers aged 35–44 years may be, as distinct from the mean income for this age category.

It is highly recommended that commercial simulations of this type utilise datasets where information, in regard to consumer attributes, is not aggregated at all. The synthesising process should receive information about each individual household. This assertion is consistent with emerging best practise in regard to the customer analytics processes used by marketing teams in large organisations. It is demonstrable in a sufficiently large number of cases, that the aggregate data may hide critical information about attribute correlation. These relationships are comparatively easily discovered if the original dataset is queried in the correct manner.

This approach differs from traditional analytical techniques in that a hypothesis about the attribute correlations is often developed late, whereas aggregated approaches are required to present all investigated relationships as presuppositions. For a highly complex, fluid and adaptive system this is obviously beyond any known capability.

5. Conclusions and Future Directions

While the data available in the public domain is insufficient to construct a simulator useful for commercial decisions, a non-commercial simulator is feasible and may be useful in identifying the strengths and weaknesses of the approach. An airline wishing to build a valuable forecasting tool will need to carefully consider the cost and legality of obtaining and developing strongly correlated data. In all likelihood an airline will already have available the most valuable of all sales prediction tools, past sales records. In many airlines, these may also be combined with valuable consumer information contained in frequent flier records. These will often be disaggregated for each consumer, but the key factor is ensuring that external attributes for each individual are correlated directly.

In Australia at least, privacy constraints prohibit the use of individual consumer data without consent. Nevertheless, this research sets the foundation for the development of a market analysis. Indeed, a simulated consumer base with imperfect data is already being constructed for certain routes in New South Wales, Australia, based on this methodology.

This approach offers the attractive outcome of providing information on the choice behaviour of individual consumers in an air-travel market. Through this simulation methodology, an airline may be able to formulate strategies for targeting more refined market segments and examine the simulated outcome of that specific targeting. The ability to reconstruct and simulate market segments and then examine the behaviour of those segments is clearly one of the key strengths of this approach.

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The analyzing of Airport Accessibility in Incheon International Airport

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Abstract

Incheon International Airport have been in constant efforts to establish hub airport in Northeast Asia since its opening of 2001 and is in process to build a variety of infrastructure. To be a hub airport, the airport access problem causing some trouble from opening the airport is one of the certainly solved problems. Right now there isn't any other access road except Yeonyuk Bridge to go Incheon airport. Therefore if the situation such as large traffic accidents or heavy snow happens the airport access would be limited and it would result in a lot of loss. This study identifies best set of explanatory variables to explain in mode choice, using the observation of trip making behavior in Incheon International Airport. Logit frame is used explain the choice behavior between car and bus. The different models are compared; using the variables of different components of travel time and costs, and attitudinal variable, second, total travel time and costs and income level, and finally, components of travel time and cost only. All models are proven to be statistically significant for overall explanatory power.

Key Words : Airport Access, Mode choice, Losit

1. Introduction

Incheon Airport that had finished the huge construction for nearly 8 years and opened started with declaring to be a hub airport of the northeast region. However, there are a lot of works to be solved for Incheon airport in order to be a hub airport.

To be a hub airport, the airport access problem causing some trouble from opening the airport is one of the certainly solved problems. Right now there isn't any other access road except Yeonyuk Bridge to go Incheon airport. Therefore if the situation such as large traffic accidents or heavy snow happens the airport access would be limited and it would result in a lot of loss. It could cause Incheon airport to lose competition power because of the vulnerability of the airport access even though the new airport constructed spending huge cost. In addition, the road access using only access means, Yeonyuk Bridge has had toll fee problems from opening the airport and not yet analyzed them precisely.

The choice of the access means for going Incheon airport is such land transportation as car, taxi, and bus until now in spite of operating Incheon airport 2 years. Currently it is necessary to analyze and estimate positively the change of the access transportation, which has already had many problems before opening the airport. As a matter of fact, the access analysis of the Incheon airport performed for the traffic forecast before opening the airport. However, it didn't after opening the airport.

This research analyzes and compares the access traffic of the Incheon airport throughout the variety of methods regarding the traffic means choice behavior analysis using traffic means choice theory. This analysis compares the forecast degree of each model using the means choice model mainly applying transport engineering and shows the means choice model for the airport access. Using both discriminant analysis and logit discriminant analysis as the means choice model analyzes the difference of two models.

2. Survey the access situation of the Incheon airport

Incheon airport is located more 30km west from Seoul than Gimpo airport. It is essential for the success of the airport operation that the accesses to the airport make conveniently and easily since the airport is located away from 55km at the center of Seoul. It forecasted using cars is rapidly decreased and using a bus is increased because the access cost of the Incheon airport in the early time of opening the airport is much more expensive than that of Gimpo airport. Unlike the early forecast, however, the access mode of the Incheon airport has been varied such as cars, taxi, bus and limousine.

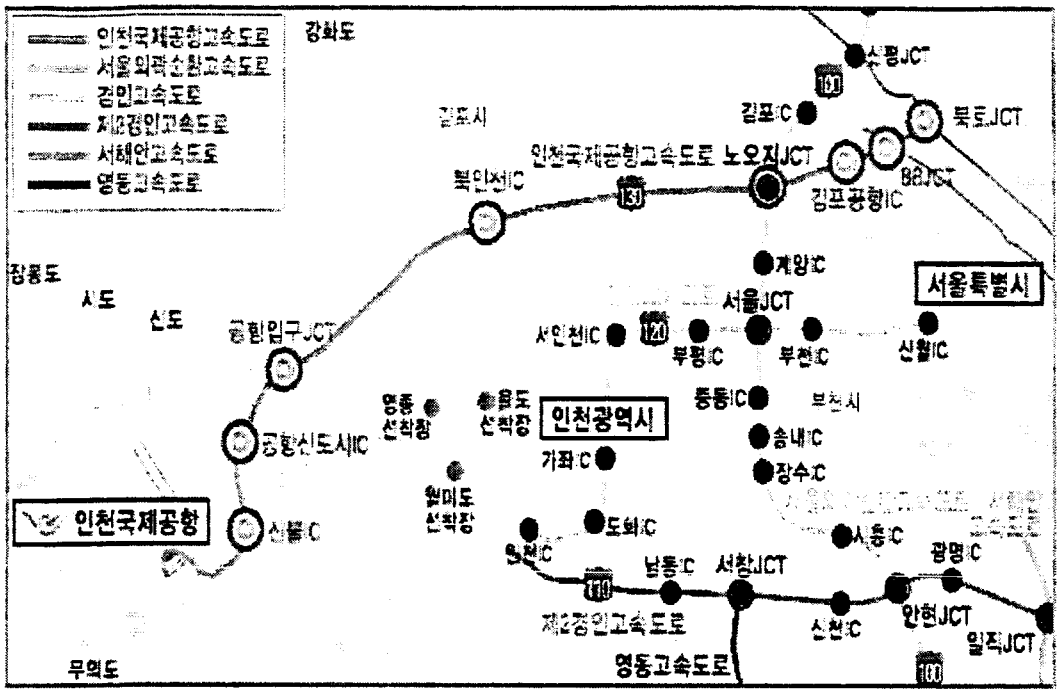

Fig. 1 Access of Incheon Airport

As Fig.1 shows, Incheon expressway is limited entrance and exit except the Nooji IC and the north Incheon IC to obtain the punctuality of the passengers.

It is made 6～8 lines and the total length is 40.22km (Banghwa Bridge ↔ Incheon airport). The entrance gates of the expressway are five gates; the north road IC connecting Jayoo road and Gang pun buk road at the northwest region of Seoul such as Eunpung, Mapo, 88IC connecting the Olympic road nearby Gangnam, Sucho, Youngdungpo, Gimpo airport IC at the area of west Seoul, Nooji IC connecting the outer cycle expressway at the area of Gimpo, Bucheon, Sihung, and Ilsan, the north Incheon IC at the area of east Inchon and west Incheon. It is planned that the exclusive train connecting between the Incheon airport and the seoul station will be constructed in 2005 and also the second Yeonyuk bridge will be built at the Incheon Songdo new city to vary the airport access at the south region of the metropolitan city. With considering the early construction investment, the toll fee of the Incheon expressway is fixed as follows.

Table 1. The toll fee of Incheon Airport(Expressway only)

Classification	Toll (Won)	Object vehicles
Small Car	4,900	Vehicles less than 800cc
Medium Car	6,100	Car, van below 16 persons, Truck less than 2.5ton
Large Car	10,400	Car, bus above 17 persons, Truck over 2.5 t and less than 10ton
Heavy Car	13,500	Truck over 10 ton

3. The theory study over the airport access mode choice

The study over the airport access mode choice is performed a lot both internationally and domestically. The study regarding Gimpo airport access mode choice before building the Incheon airport and recently the study of the access mode choice in the Incheon airport are performed. These study analyzed factors, which are considered when the access mode is selected. Ashford(1995) chose the three factors such as cost, comfort, convenience. In addition, as <Table 2> shows, it is considered not only the service level of the mode but also the relative level over other modes when the access mode is selected using the factors.

Table 2. The priority ranking over choosing the access mode

Ranking	Contents
1	Easy baggage handling
2	Connection convenience
3	Transit hours
4	Traffic means comfort
5	Using parking lot
6	Transfer convenience
7	Transit hours
8	Delay & congestion

Source: Ashford et al, Airport Operations 2nd, MacGraw-hill, 1995.

H.W shiriner and L.A. Hoel(1999) conducted the survey regarding the access services over 111 airports. In accordance with this survey there is no interrelation between the access and the airport size and the biggest problem is the congestion of the terminal curbside. Also it analyzed no interrelation between the possibilities of using public transportation and the airport size [reference 1]. However, the possibilities of using public transportation is clearly different according to the airport size and all airports including the large airports is available a bus while the airports including the medium and small airports show the load factors of 60%. This study method about the access in the transportation field started from establishing the relating model between land use and transit in 1950s and Hansen(1959) designed the access

index for forecasting population spatial distribute. This model is amended and added a variety of types so that is developed gravity model, Lowy model, Wilson's entropy maximum model and so on.

The access ability in the transportation field is used the base of the moving ability from one point to other point. After that, it has been used the variable of transit demand forecast model and studied the base on the behavior of the transit passengers. Until now the method used for the airport access mode choice analysis is mainly the individual probability model based on the behavior theories. This individual probability model is removing big errors that occur due to the mass of data so that it has the certain reliability and it could analyze using just a few data. These kinds of models are discriminant model, logit model and probit model and merits and demerits are below.

3.1 Discriminant Analysis

Discriminant Analysis is used to classify cases into the values of a categorical dependent, usually a dichotom. If discriminant function analysis is effective for a set of data, the classification table of correct and incorrect estimates will yield a high percentage correct. Assuming a multivariate normal distribution of quantitative variables within each level of classification variable, a parametric method generates a linear discriminant function and composed as below

$$D^i_{jk} = C^i_0 + C^i_1(X_{j1}, X_{k1}) + C^i_2(X_{j2}, X_{j2}) + \ldots + (C^i_t(X_{jt}, X_{kt})$$

The numeric value of the discriminant function is different for each subject, and the treatment subgroup determined from discriminant analysis may or may not be the same as the actual treatment subgroup. The more subjects with the same classified and actual treatment subgroup, the better the effect of separation. Taking into consideration the effect of all quantitative variables, this discriminant function produces the statistical decision for guessing to which subgroup of classification variable each subject belongs.

The performance of discriminant analysis can be evaluated by estimating the error rate (probability of misclassification).

3.2 Logit Analysis

The logit model is one of the most widely used discrete choice models in econometrics for three main reasons. First, it is easy to estimate due to the functional form of the logistic distribution. Second, it can be motivated as a model of choice between alternatives with random utilities, where the randomness comes from independent draws from an Weibull distribution. Third, it gives rise to a linear log-odds ratio which leads to a simple interpretation of the parameters.

When considering mode is 2(ex, car and bus), Generic logit model is follow;

$$P_C = \frac{\exp(U)}{1+\exp(U)} \quad (P_C: \text{C Mode select probability})$$

$$P_C = \frac{1}{1+\exp(U)} \quad (P_B: \text{B Mode select probability})$$

The logit formulation is not a complex mathematical function nor is the utility function it employs. The difficulty in developing a logit model is encountered in estimating the considerable number of parameters for variables in the utility function. The estimation is accomplished using one or another multivariate statistical analysis program to optimize the accuracy of estimates of coefficients of several independent variables.

3.3 Pobit Analysis

The probit model is a popular device for explaining binary choice decisions in econometrics. It has been used to describe choices such as labor force participation, travel mode, home ownership and type of education.

$$P_C = \Phi(U) = \frac{1}{\sqrt{2\pi}} \int_U^{\infty} \exp(-\frac{1}{2}t^2)dt$$

$$P_C = 1 - P_C = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{U} \exp(-\frac{1}{2}t^2)dt$$

The logit and the probit models are quite comparable, therefore the choice between the two is of mathematical convenience and ready availability of computer programmes. Where the logit model is based on a logistic cumulative distribution function, the probit is based on a normal cumulative distribution function. The probit model is mainly used where the utility theory, or rational choice perspective on behavior is used. In numerous applications, it is found the when the independence of the utilities is assumed, then there is not much difference between the result.

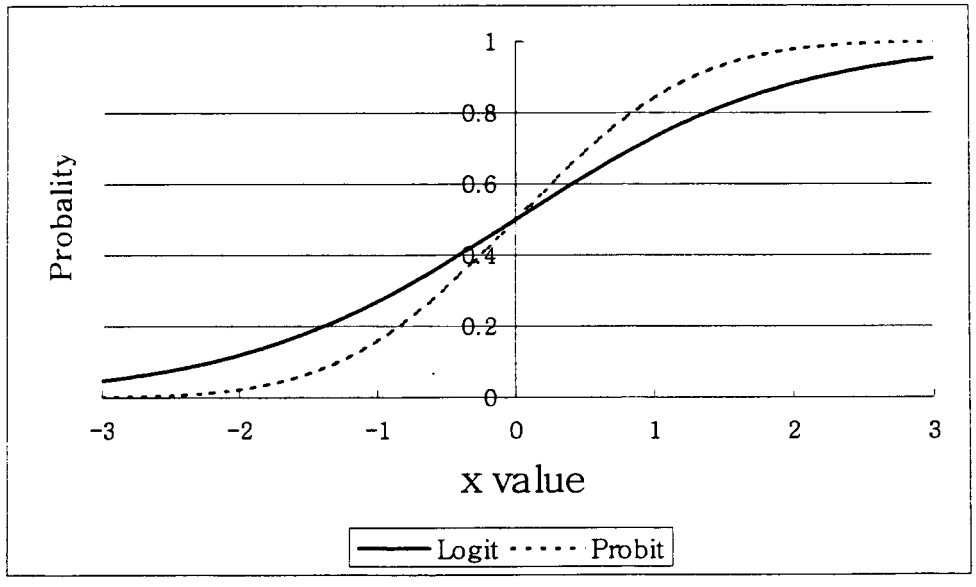

Fig. 2 The comparison between Logit model and Probit model

4. Model Presumption and Analysis

4.1 Data Entry Characteristics

The data used in this study is selected from Incheon Airport-related data of survey for the status of City Air Terminal User (Korea of Transport Institute, Korea Civil Aviation Development Association), which was performed twice times, through July and August, 2002.

The analysis of the survey is achieved through analyzing 201 questionnaires, executed and collected four times, twice in weekday, the others in weekend

- Analysis Specification
  - vital statistics: gender, age, job, the number of car owned and ventilation capacity, the location of departure
  - survey of terminal use status: frequency of domestic airtrip, frequency of international airtrip, The purpose of terminal use, transportation mode used, time taken
  - survey of favorites: favorite access mode, consideration for favorite access mode selection, another favorite access mode and consideration when in case of change of access mode

The surveys was paralleled with two surveys; one is the survey for Revealed Preference(RP) which grasp the characteristics of social, economic aspects and passage of Incheon airport users, the other is for Stated preference(SP) which graps the change of favorites according to the virtual change of specific transportation variables.
Among 201 surveyed for Incheon Airport users, 62% was men and the rest 38% was women by gender, 60% was 20-30ies by age. 80% was taken by answerers below twice by annual frequency of domestic and international air trip. The purposes of terminal use headed by abroad travel, followed by abroad work, welcome and send-off, airport work, and commuters.

The most favorite mode for airport users was airport limousine by 50%, followed by car, Express bus and taxi. The reason airport limousine took high portion of airport users was that it was answered airport limousine, through bus, suburban bus, and local bus all together as limousine. So it is not too much say that the rate of bus was arrived to 70% as Incheon airport users access mode.

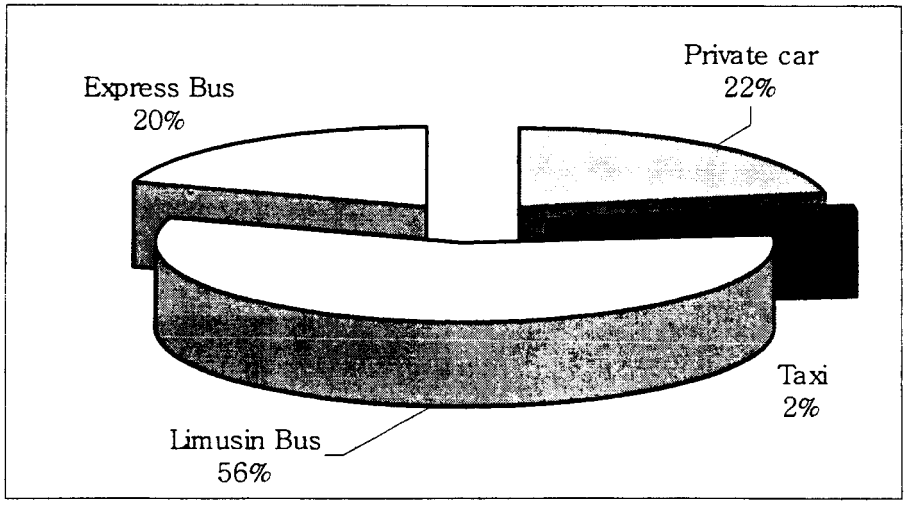

Fig. 3 The chart about the access mode of Incheon Airport

To the question asking consideration for selection of Incheon Airport access mode,,the accessibility and punctuality are positioned most high, as below Fig 4. At the survey for user's favorites according to arranged to open rail and the 2nd girder bridge, the airport bus is most highly, on the other hand, the rail ,relatively low as Fig 5. This was result from combinating airport limousine and through bus as one, airport bus, which respondent were not conscious of difference between two transportation modes.

In Fig 6, after opening rail and 2nd girder bridge, the most considerable factor for access mode is transmission, followed by fare and time taken.

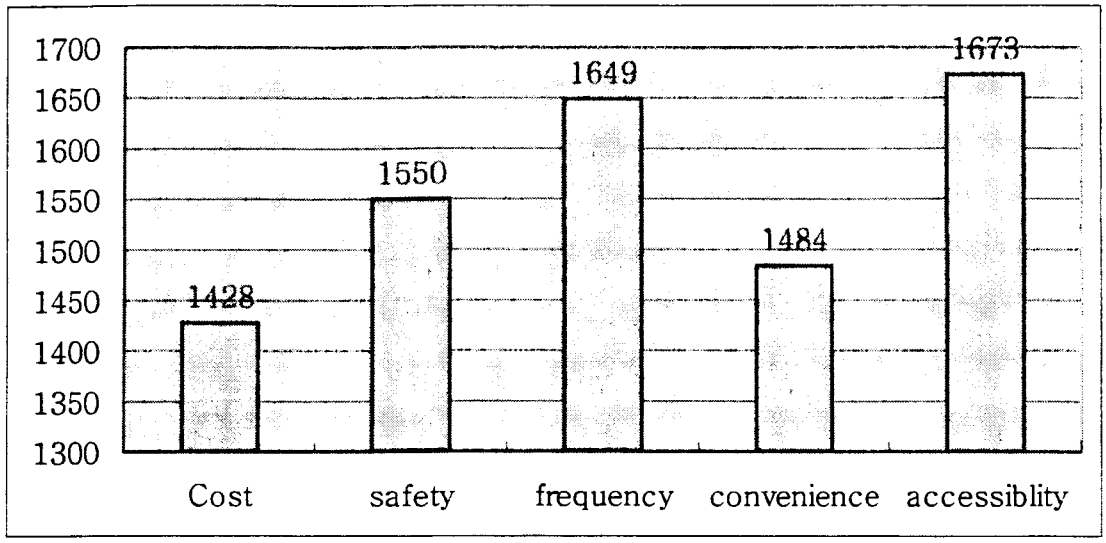

Fig 4. Considerations over choosing the access mode of Incheon Airport

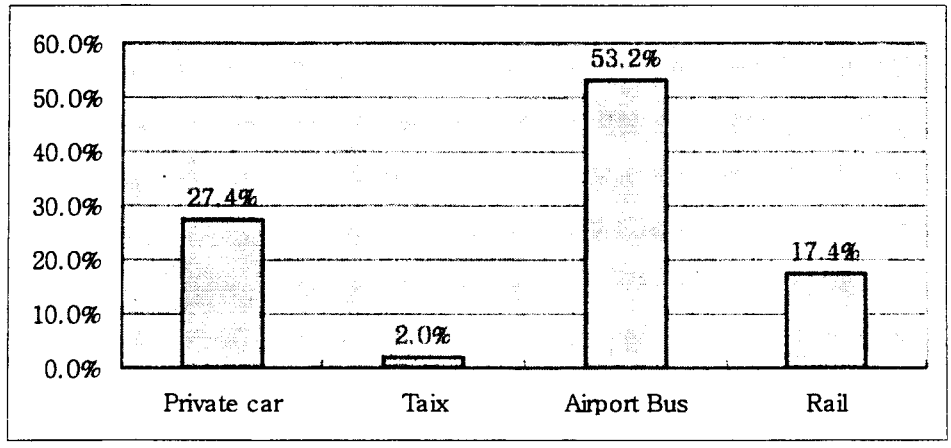

Fig 5. The priority ranking over choosing the transportation mode when the access changed

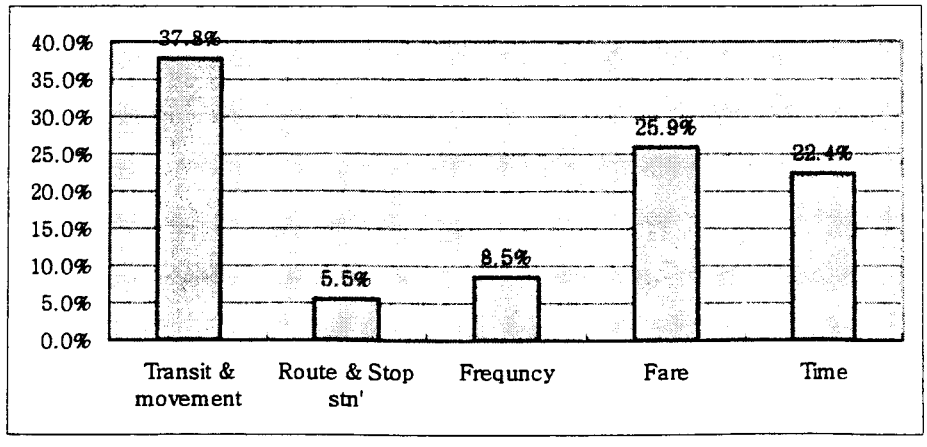

Fig 6. The priority ranking over considerations while choosing the transportation mode

As seen in favorites surveys, the favorite transportation modes are bus, followed by car, rail, and taxi one by one. As seen from this result, the access to Incheon Airport can be analyzed by grouping as car and bus.

The selection for access mode to Incheon airport is largely two-grouped as car(private car+taxi), bus(airport limousine+Express bus) and difference is analyzed after seeing discriminant analysis and logic analysis.

4.2 discriminant analysis for access mode selection

The discriminant analysis was performed with locating selection for access mode to Incheon airport as subordinating variables and age, income, frequency of domestic air travel, frequency of international air travel, cost expended, and time taken as independent variables.

The selection variables to Incheon airport access are set as car and bus; the latter is made of Express bus and limousine bus and the former, taxi and car, which were distinct as separate selection groups. The verification for homogeneity between two groups are known by wilks' λ and statistics amounts through it.

Table 3. Verifying the homogeneous quality of group average of discriminate analysis

Variables	Wilks λ	F	meaningful probability
Age(X1)	0.962	7.881	.005
Income(X2)	0.949	10.796	.001
Domestic frequency(X3)	0.943	11.982	.001
International frequency(X4)	0.939	12.845	.000
Cost(X5)	0.378	327.799	.000
Time(X6)	0.784	54.727	.000

The Fisher's first discriminate function which deciding distinction grades of each groups to the level of meaningfulness of each variables, is as below.

$$Y_C = -21.078 + 2.025 X_1 + 0.598 X_2 + 0.317 X_3 + 3.304 X_4 + 7.512 X_5 + 4.180 X_6$$

$$Y_C = -13.609 + 2.088 X_1 + 0.571 X_2 + 0.184 X_3 + 2.652 X_4 + 1.671 X_5 + 1.103 X_6$$

Seen from this discriminate function, the higher the frequency of domestic or international air trip, the more favor car; the more spend the trip cost and time, the more favor car.

This can be intuited by the size of parameters of each independent variables, also can be achieved the fact that both bus and car are more sensitive to cost than time because the parameter of time is larger than that of cost. Seen from Fig 6 result, transfer and cost are larger selection facts than routes, frequency, and time in choosing transportation modes, and from the larger two facts; the cost are more effectible than transfer.

As a result of discriminating, the group chose car appeared to all selecting cars. In case of bus, otherwise, the discriminant credibility was 95.8% that from 142 who chose bus, 136 selected bus. So the whole discriminant credibility was 97% and can be perceived that the discriminant formula classifies the target group in a pertinent way.

Table 4. The estimation results of discriminate analysis

		prediction group		Total
		0	1	
Frequency	0	59	0	59
	1	6	136	142
%	0	100	0	100
	1	4.2	95.8	100

note) 0 : car, 1: bus

4.3 Logistics analysis for access mode selection

When it compared with general discriminant analysis, the logistics of discriminant analysis suppose the functional relationship between subordinate variables and independent variables as non-linear rather than linear. So it can be required the flexibility of supposition because the standards can be composed of linear, disperse, or mixed one. The logistics discriminant is made of two subordinate variables; bus and car as in this study, it can be defined below.

$$\ln[\frac{f_1(x)p_1}{f_2(x)p_2}] = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_p x_p$$

To calculate of each group's ex post facto probabilities, the logistics discriminant analysis use a Logit transformation which transforming subordinate variables of disperse type into S-shape curve which dispaly a probabilities of certain case.

$$\frac{q_1(x)}{q_2(x)} = \log it(p) = \ln(\frac{p}{1-p})$$

This study is applied a Logit discriminant model using Limdep v7.0. Seen from below Table, as a result of analysis, it was selected as a meaningful variables at meaningful level of 0.01 and the statistical value of the variables are shown below.

Table 5. The results of analyzing Logit model

variables	coefficient	standard error	b/St.Er	P[|Z|>z]
constant	5.229	1.855	2.819	.0048
tcost	-.680E-03	.171E-03	-3.978	.0001
ttime	0.111	.291E-01	3.798	.0001

note) tcost : trip cost, ttime : trip time

From this result, it can be achieved that it is higher the passage cost, the more inclined to select car than bus and it takes more time, to select mass transportation mode, a bus. The logistics discriminant model is as below and the classification rate is seen as below table 6.

$$\frac{q_1(x)}{q_2(x)} = \exp(5.229 - 0.00680 tcost + 0.111 ttime)$$

Table 6 The estimation results of Logic model- discriminate analysis

Survey		0	1	Total
Frequency	0	58	1	59
	1	1	141	142
%	0	98.3	1.7	100
	1	0.01	99.9	100

note) 0 : car 1: bus

Though had a little difference, the predicted result from logit discrimination model has strength in classifying selection behavior accurately than discrimination and the right classification rate come to nearly 99%.

5. Conclusion

Comparing logit discriminant model and discrimination model, the former has strength in putting its theological base on behavioral theory. Therefore, it is judged that logit discrimination model is more desirable when setting up the access mode selection model for incheon airport. Though analysis result had not been analyzed by Probit model, it is judged much superior tool to predict selection of three transportation modes as other.

All the independent variables, however, which being statistical meaningful at results from discriminant, are rejected in logit discriminant model. The independent variables are composed of nominal measures, it is not be seen these variables follow regular distribution. Therefore, it is judged that the logit discriminant model, which can mitigate the supposition of regular distribution of independent variables, is logically reasonable than discriminant model.

On a conclusion, for a logit discriminat model, there is theological merit with superiority or equivalent in aspect of statistics and data explanation. As increasing the number of variables, the credibility of its credibility are decreasing due to its corelationship and are not getting distinct in the capacity expression of selection behavior. So it is necessary to vary the explanatory variables so that mode selection behavior can be explained with a little data. Because the data on passage distance and passage time were drawn from survey responses, and not a accurate sum, so it can be said this study has an analytical limitation. This study is said to be substantially worthwhile as analysis for understanding the phenomenon of transportation mode selection by users after Incheon airport's opening. In the future, to extend this study and induce more accurate result, it is need to expand the analysis according to the procedures used in this study through executing actual survey on selecting access modes, subdividing the access mode and analyze including future expanded access modes.

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Future Requirements and Concepts for Cabins of Blended Wing Body Configurations - a scenario-based approach

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Abstract

With a scenario of a strong aviation business growth of around 4,7 % p.a. in the next thirty years passenger volumes will multiply by a factor of at least two-and-a-half until the year 2020 [1] and almost quadruple ten years later. To cope with such a high demand requires new aircraft configurations to ensure and improve operational efficiency, productivity and customer value in a highly competitive market environment. A promising future aircraft configuration for this purpose is the blended wing body (BWB) with a reasonable chance to enter the market by 2030. The early stage of development of this configuration leaves many open questions, especially with regard to the aircraft's cabin. As interface between the passenger, the airline and the manufacturer it will be in the future an even greater contributor to the competitiveness of an aircraft than it already is today. The following process addresses the importance of this primary aircraft system and develops key requirements and first concepts for future BWB cabins.

The strong influence of unpredictable factors on the development of future concepts for BWB cabins implies the methodology of scenario techniques. The scenario process performed at TU München together with Airbus Deutschland GmbH, DaimlerChrysler Society and Technology Research Group (RIC/Y) and iDS, industrial Design Studio, comprises the development of three different scenarios, the implication of specific requirements and the realization of preliminary cabin concepts. To cover a broad range of potential evolutions, the three scenarios chosen evolved in a generous, innovative and a conservative development of future BWB cabins. On the basis of current cabin standards of the A380, new standards for the BWB cabin designs were quantitatively derived for each scenario as well as this was done qualitatively for a portfolio of essential new technologies, which are formulated as technology recommendations for the aircraft. According to these inputs, 2D cabin layouts and specific system solutions have been developed and sketched to visualize the concepts. In a final step, specific requirements have been evaluated in all scenarios to identify their compatibility in the respective future environments.

Keywords: Blended Wing Body, aircraft design, cabin development, cabin design

Introduction

With a scenario of a strong growth of the aviation business in the next thirty years passenger volumes will multiply by a factor of almost four. Taking into account that capacity in the air and at major hub airports already is evolving as a limiting factor and that airline efficiencies will have to improve from nowadays levels, aircraft with higher productivity yields may play a major role in the future of the aviation system. This could lead to a concentration of large passenger flows through hub airports with little available capacity, demanding for larger and operational cheaper aircraft to address this market environment.

The conventional aircraft configuration is reaching its optimum and even scaling effects with bigger airplanes do not provide the potential for leap improvements. Though claiming superior economics over current large airplanes, the introduction of the Megaliner A380 seems to be the upper limit of size for conventional airplanes and is a probable transition to a next generation of aircraft, which combine extremely low fuel burn with high capacity, high environmental compatibility, low operating costs and operational flexibility for airlines (figure 1).

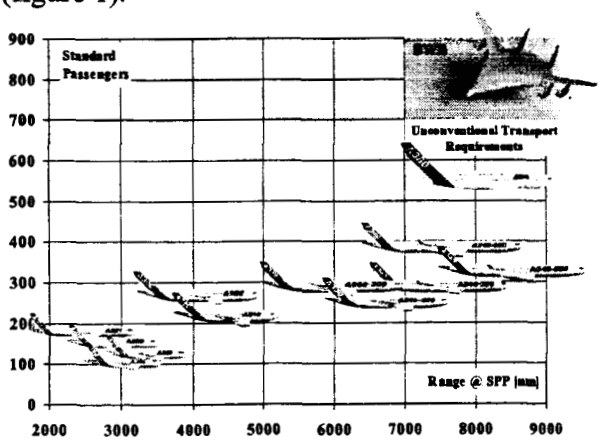

Figure 1: Airbus product line and BWB profile

Besides a number of aircraft configurations being investigated to comply with the strict requirements, the Blended Wing Body (BWB) is closest to a realization, being discussed by both large aircraft manufacturers. As a compromise between the aerodynamically high performing flying wing and the evolutionary optimized conventional airplane it offers significant advantages for operators, which is especially true for larger sized aircraft.

As the foreseeable entry into service of this type of aircraft is some time into the future, derivation and assessment of requirements reflecting market demands is difficult. This is explicitly the fact for the cabin of the aircraft, as it embodies the direct interface between the operator, customer and manufacturer in a competition driven environment. The importance of an early view on different cabin development paths by derivation of basic cabin requirements in the young stages of BWB development can be underlined with the broad variety of different BWB designs currently developed at aircraft manufacturers, scientific institutes and universities.

However, to maintain competitive advantage it is vital for new aircraft characterized by a long life and product cycle to be as attractive as possible over a maximum period of time. Therefore, the identification of robust cabin requirements becomes eminently essential as it determines the main portion of cabin development at the start of the aircraft program and will have major influence on the potential to adapt to modified customer requirements later on in the product life cycle.

Approach and Aim

The large number of unpredictable factors from various environments like the socio-economic, the air transport related, political or technological area has a great impact with considerable uncertainty on the design process. The geometric spacious room inside the BWB fuselage with unknown varieties for new cabin solutions describes a completely different type of product, for which a classical design approach is not convenient any more. This leaves even more uncertainties for the derivation of BWB cabin requirements. Therefore, scenario techniques are applied as proposed by [2] to work out a qualitative set of comprehensive future product environments which drive the development of the BWB cabin.

The aim of the process has been to derive hard figures for key cabin parameters like seat pitch or number of galleys on the one hand and soft qualities regarding incorporated technology and process profiles on the other. With this approach, the aircraft manufacturer is capable of evaluating basic cabin design variants and options to be prepared for different customer

requirements and challenges coming from the operator. This is vital from a technological as well as marketing (offer to airlines) point of view. As a consequence, there have been made no restrictions regarding structural layout of the BWB, for example the concepts of single pressure, double hull or load supporting elements for the inner structure.

The BWB aircraft is an Airbus designed configuration with the performance displayed in figure 1. The usable cabin area is geometrically given and constant (no scaling) for all scenarios. Figure 2 shows the significant difference with a conventional fuselage.

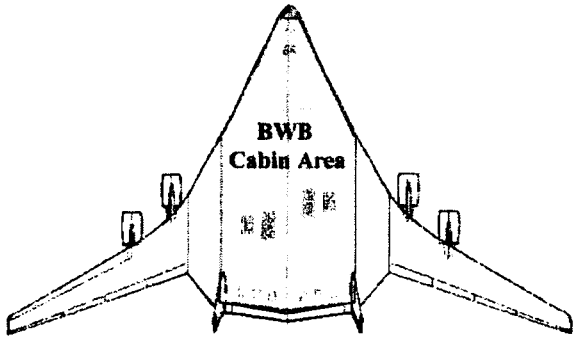

Figure 2: BWB Configuration [3]

Developed scenarios

The analysis comprises the development of three different scenarios to cover a relevant range of potential evolutions. The following general assumptions accompany all scenarios, as they characterize the development of the air transport system until 2030, which justify the introduction of BWBs [4].

- Global economic growth of over 3% p.a. on average
- Global strong growth of air traffic volume of over 4.5% p.a. on average
- Share of hub & spoke connections increases
- Long haul routes are predominantly served by very large aircraft
- Long routes are basically operated by full service carriers

Parallel to these market conditions, the following factors have been discussed as premises throughout the entire process:

- Importance of flight time gains weight
- IT-technology continues to propagate globally into society
- Anthropometric dimensions of human beings grow bigger
- Cabin safety improves
- Medical care evolves further

The relevant scenarios, all of which have been treated equally, are presented hereunder.

Scenario: "Chief Pax"

This positive reference scenario describes an optimistic environment in which political and socio-cultural stability ensure a steady economic development with a steadily increasing living standard. Further cornerstones of this scenario are:

- Growing wealth in most of the global regions create passengers with a high demand for comfort and service. This is addressed by airlines with an enhanced supply of in-flight values, covered by higher air fares. However, the relative value per price is increasing resulting in profit margins comparable to today's.
- The variety of different nationalities traveling the air and the distinctive individuality of the passenger as a result of higher living standards turns religious and cultural identification on board into a key driver.
- Conventional aircraft classes are refined into more and smaller user groups to react on individual needs. Passenger convenience is realized by both personal assistance by the crew and onboard systems.
- Extensive advances in innovative technologies and processes permit a high constructional flexibility to quickly and efficiently change cabin layouts.
- Growing restrictions from environmental issues and certification are addressed by new technologies.
- Additionally, the awareness for health (e.g. thromboses issue) is increasing.
- BWB airplanes meet the expectations of airlines and passengers which lead to a high public perception.

Scenario: "Slow Motions"

As a projection of today's trend to rationalization, this slowly developing scenario shows little motivation to leap innovations, founded in a deeper society problem affecting airline strategies as well.

- Despite economic growth society is split into a small wealthy group and a large population stratum with a stagnating living standard. The gap between the (lower) middle and upper class widens which leads to social inequities and is especially a phenomenon of the triade (USA, Europe, Japan).
- Due to the strong competition airlines are as today under pressure to operate with low fares and high productivity, leaving small profit margins per seat sold. Passengers have not been able to organize themselves into a powerful entity expressing their needs towards the airlines, while dragging certification processes hinder operators to introduce new standards. The evolution is moving inert and slowly resulting in conventional cabin designs with few classes.
- The widespread application of technology has overtaken many procedures in daily life, leaving many people, especially older, overstrained. The development into a two class society results in a general decline of educational and intellectual standard. Still attracted by low ticket prices, this produces a significant higher number of passengers requiring support and assistance. The demand for help services is gaining weight, because the understanding of onboard processes and technologies is missing throughout broad parts of the flying society.
- The BWB convinces airlines, but only has moderate acceptance from the passenger.

Scenario: "Flying Heavenly Peace Square"

The metaphoric title aims at a specific Asian market development ascending up to 2030 which is taken as a major driver for this relevant scenario.

- Economic growth pushes the tiger states to a similar living standard as in the western world, leading to a long running boom in air traffic in and with this region.
- An over the years steady technological evolution leads to a high standard and is the basis for sophisticated technological solutions.
- Airlines face declining profit margins with a higher demand for in-flight convenience and can only react with highly operationally efficient cabin concepts and layouts. The need for a physical one class layout is one of the measures taken, evolving from a gradual transition on the Asian market towards fewer classes, which started with the advent of high passenger volumes on shorter hub routes to achieve throughput and efficiency.
- To minimize operational cost, extensive cabin modifications in the aircraft during idle periods or even turn-arounds are not wanted by operators to maintain a simple and cost-effective structure.
- To attract passengers, the cabin design, functionality and quality is emphasized along with the impression of the cabin's appearance as a premium product. Because of substantial differences in culture, it is a priority to address special considerations to the development of an adequate traveling environment.
- Ticket price mix and marketing options for airlines are realized by seat-individual service concepts sold at travel agents, airlines or operators, in which both the technological facility standard and the in-flight comfort service can be booked.
- The awareness for health issues on long range flights increases throughout society.

BWB Cabin Standards

The derivation of key requirements for cabin development from the specific scenario follows the methodology as described in the figure 3.

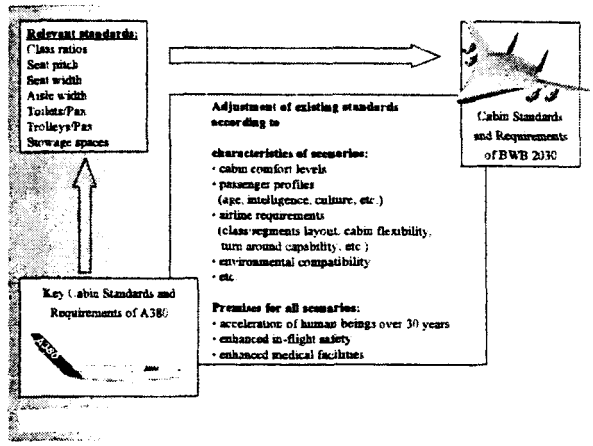

Figure 3: Derivation of BWB cabin standards

Taking cabin standards displayed in figure 3 of the A380 as a reference, standards for the BWB cabin are tailored according to the requirements of the specific scenario. The main

geometric standards are class ratios, seat pitch, seat width, aisle width, toilets/pax, trolleys/pax and stowage spaces. These are influenced on the one hand by the relevant characteristics of the different scenarios, but on the other hand by general premises having impact on all of the scenarios as well. These are the continuous growth of human being's dimensions known as acceleration [5], enhanced in-flight safety and medical facilities. Acceleration for instance is causing an increase in body height of about 1,5 cm in 30 years, justifying a seat pitch gain of one inch as the operational life of aircraft is another 30 years from that point on. Thus, only one inch more pitch already results in a reduction of at least one row in the given BWB aircraft and thus has a direct impact on capacity and productivity.

For every scenario a set of basic technologies is identified to establish a general level from which the different scenario implications develop. The mains can be summarized in the following list:

- Communication with broad band internet
- Wireless blue tooth like support of mobile equipment (phones, laptops, pagers, etc.)
- Online information system (passengers, cabin systems, stock data) for the crew
- Intelligent boarding / deboarding systems optimizing on-board processes

Generation of 2D-Layouts

With these new standards, the number of seats in the BWB cabin is calculated. The procedure is shown in figure 4.

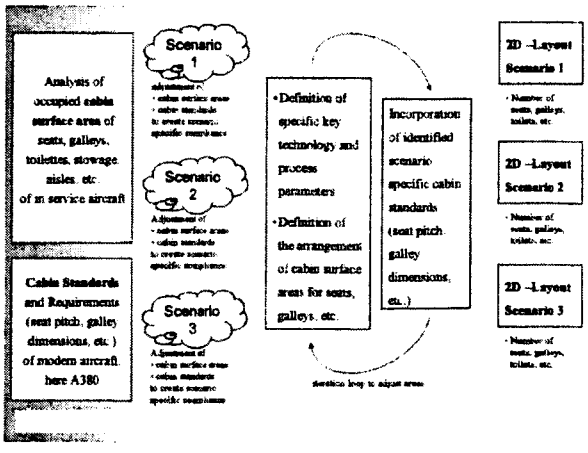
Analysis of occupied cabin surface area of seats, galleys, toilettes, stowage, aisles, etc. of in service aircraft
Cabin Standards and Requirements (seat pitch, galley dimensions, etc.) of modern aircraft, here A380
Scenario 1
Scenario 2
Scenario 3
•Definition of specific key technology and process parameters
•Definition of the arrangement of cabin surface areas for seats, galleys, etc.
Incorporation of identified scenario specific cabin standards (seat pitch, galley dimensions, etc.)
2D -Layout Scenario 1
2D -Layout Scenario 2
2D -Layout Scenario 3

Figure 4: generation of 2D-Layouts

Firstly, the seat areas within the BWB cabin are determined according to the given ratio of the absolute seat area and total cabin area of nowadays modern in service aircraft (figure 4), which is typically up to 55%. Subsequently, with the given fuselage and unaffected by the need to scale the aircraft for a dedicated number of passengers, aisles, galleys and other remaining surface areas are derived conformable to scenario needs. Also door positions, sizes and emergency evacuation paths are planned as part of the total cabin concept.

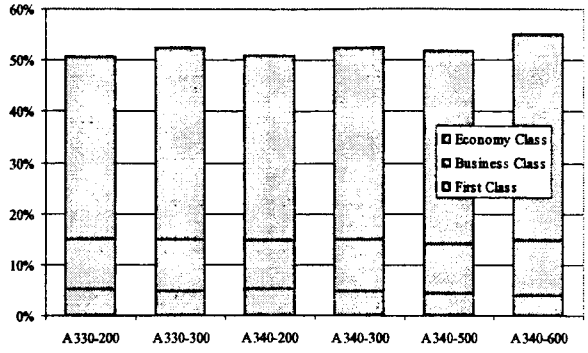

Figure 5: absolute seat area as portion of total cabin area

Along with consequent and logical rationales, the following scenario specific standards for different cabin and operational concepts have been found:

Scenario "Chief Pax"

Kabine BWB 2030	Standard 2000 (A380)			Standard 2030 (BWB)				
	FC	BC	EC	FC	BC	EC1	EC2	EC3
Class ratios in %	4	16	80	5	12	83		
Seat pitch	62"	40"	32"	64"	42"	35"		
Seat width	30"	27,5"	25"	32"	30"	27"		
Aisle width	min 500 mm			min 570 mm				
Toilets / Pax	1 / 10	1 / 25	1 / 45	1 / 10	1 / 21	1 / 30		
Trolleys / Pax [a]	1 / 2	1 / 4	1 / 10	1 / 2	1 / 4	1 / 10		
- Stowage space / Pax	25"x2"	25"x1,5"	1 Tray	25"x2"	25"x1,5"	25"x1"	1 Tray	1 Tray
- Hand luggage	2	2	1	3	2	1		

Table 1: 2D- Layout dimensions "Chief Pax"

The high living standard and individuality combined with powerful communities of interest in this scenario enforces the influence of passengers as a stakeholder in the airline business. Airlines have to react on this demand with a personalized offer to defined passenger groups like families, older people, youths or different business passenger clienteles. This is reflected by airlines with the creation of additional segments within the classical classes, especially in the economy class. As can be seen in the diagram, the class layout has been adjusted to meet different demands, which are related to ticket price and offered service.

With aisle widths orientating at conventional dimensions, cabin layout has to be designed attractively to achieve a high perception from

the passenger. An unconventional approach of a bended main broad aisle (2m) assures a quick boarding and deboarding in the critical entrance areas. The known approach of a three-divided cabin of main classes with first in the front is maintained. High service levels are addressed with additional facilities in the lower deck compartments with crew rest rooms, fitness children and a social meeting point (with bar). Assistance for the passenger is obtained in the front and the middle information desk to explore the full range of service supply during flight (i). Two additional service points (s) in the economy classes underline the higher quality traveling level.

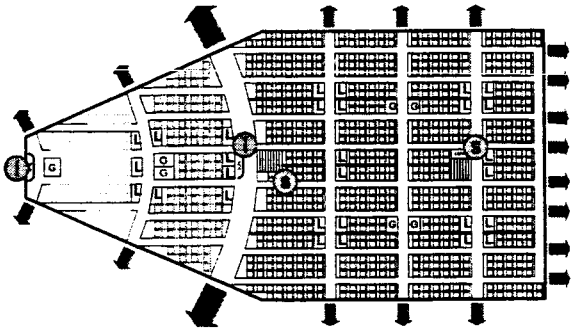

Figure 6: 2D layout with emergency exits, 730 pax

Emergency exits are provided all around the cabin area with wing and aft exits according to FAR 25.807 of type B dimensions (75 passengers per minute), two type A doors per side in the front (110 passengers per minute) and the main entrance with a new standard type 0 door (double Type A with 200 passengers per minute). The design ends up with 730 passengers in a standard layout. Some artist impressions of the cabin are elaborated hereunder.

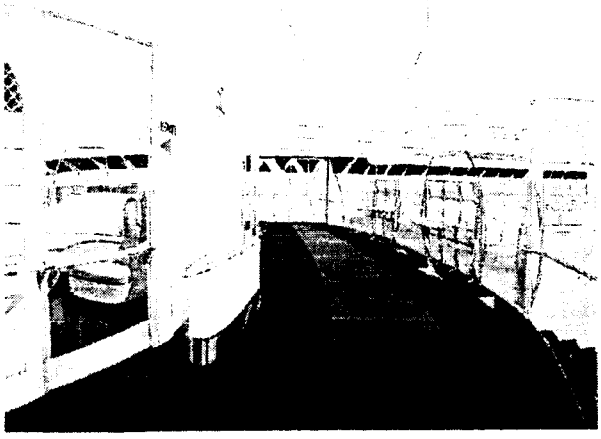

Figure 7: 3D impression of main aisle

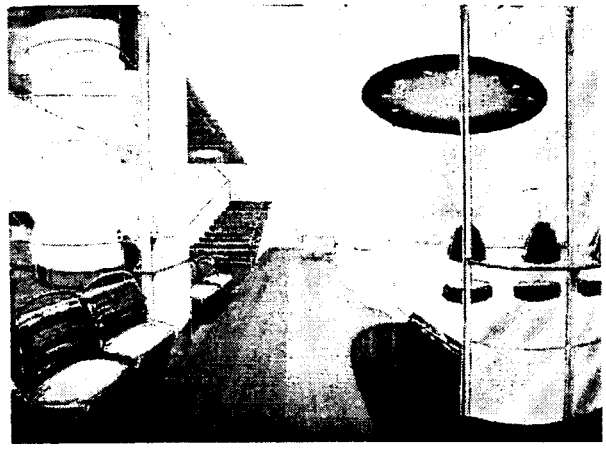

Figure 8: 3D impression of lower deck facilities

Scenario "Slow Motions"

Kabine BWB 2030	Standard 2000 (A380)			Standard 2030 (BWB)		
	FC	BC	EC	FC	BC	EC
Class ratios in %	4	16	80	4	16	80
Seat pitch	62"	40"	32"	65"	42"	33"
Seat width	30"	27,5"	25"	32"	29"	26"
Aisle width	min 500 mm			1m	0,95m	0,9 / 0,8m
Toilets / Pax	1 / 10	1 / 25	1 / 45	1 / 10	1 / 25	1 / 45
Trolleys / Pax [1]	1 / 2	1 / 4	1 / 10	1 / 2	1 / 4	1 / 10
- Stowage space / Pax	25"x2"	25"x1,5"	1 Tray	25"x2"	25"x1,5"	1 Tray
- Hand luggage	2	2	1	3	2	1

Table 2: 2D- Layout dimensions "Slow Motions"

The development into two classes divides society and thus the treatment of passengers during flight as well. With declining profit margins, the inert evolution of new and innovative cabin ideas the low paying traveler leads to a conventional standard class system. The lack of airline demand for conversion of cabin elements in or during aircraft operation entail limited flexibility for cabin elements. Major cabin reconfigurations can only be realized at C or larger maintenance checks during aircraft overhaul. The scenario is characterized by the strong differentiation between standards of high revenue first and business and low revenue economy class, which is for example obvious with the number of galleys and toilets per passenger. Service as well as supplied technology levels is significantly down-graded in economy class, focusing on efficiency and productivity for the airline. However, the larger share of older, immobile (wheelchairs) and more weightily passengers demands larger aisles. The service concept ensures a convenient and quick operation through an automatic trolley distribution system with elevators which are integrated in the emergency stairs leading to the roof. The highly cost-efficient systems for simple operation limit the comfort of the passenger. On the

other hand, first and business class have an optimized traveling environment and high-end service standards. Sophisticated comfort levels with on-seat climate, individual ergonomic adjustable seats, sound and light surround the high yield passenger which generates the major part of the airlines' revenues.

The location of crew rest compartments as well as the accommodation of trolleys in galleys at the lower deck realizes more productive seat area at the main deck.

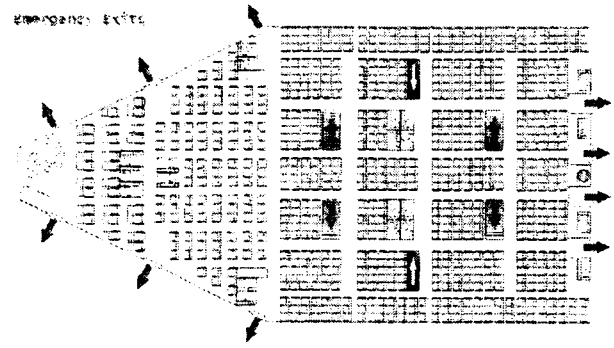

Figure 9: 2D layout with emergency exits, 808 pax

The design ends up with 808 passengers in a standard layout. Some views of the cabin are sketched hereunder.

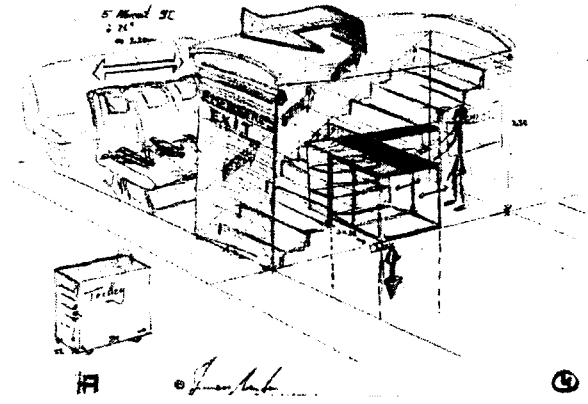

Figure 10: 3D sketch of emergency stairs

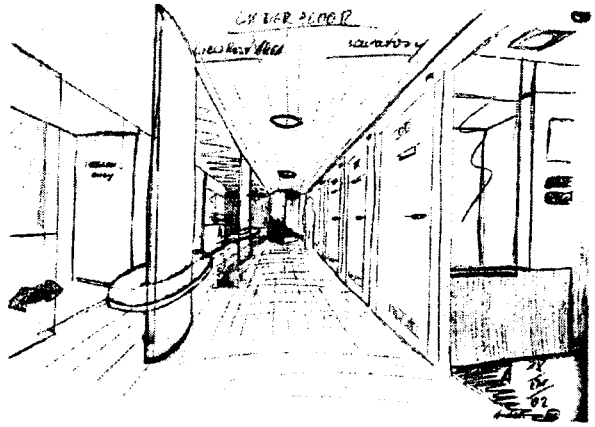

Figure 11: 3D sketch lower deck crew rest and lavatory

Scenario "Flying Heavenly Peace Square"

Kabine BWB 2030	Standard 2000 (A380)			Standard 2030 (BWB)	
	FC	BC	EC	Standard config.	High density config.
Class ratioe in %	4	16	80	100	100
Seat pitch	62"	40"	32"	36"	34"
Seat width	30"	27,5"	25"	27"	27"
Aisle width	min 500 mm			1,0 / 0,6m	
Toilets / Pax	1 / 10	1 / 25	1 / 45	1 / 32	1 / 42
Trolleys / Pax [1]	1 / 2	1 / 4	1 / 10	1 / 6	1 / 8
- Stowage space / Pax	25"x2"	25"x1,5"	1 Tray	1 Tray	1 Tray
- Hand luggage	2	2	1	2	2

Table 3: 2D- Layout dimensions "Flying Heavenly Peace Square"

The proposed single class layout has been worked out along with the demand for high profitability. Two versions are presented by the manufacturer to the airline: A standard configuration with larger seat pitch (36", 768 passengers) and a high density configuration with reduced 34" pitch and 871 passengers to comply with the greater traffic volume on inner Asian routes. As the most innovative scenario, a passenger container system is developed to achieve short turn-arounds (higher frequency) and high operational efficiency. The dashed line shows the contours of a container, which is boarded in the airport area, transported to the aircraft and loaded from the tail into it. The inner service area (dotted line) with galleys and toilets are built-in elements with a high degree of automation. Intelligent robot trolleys assist the crew with cabin operations, for instance, and take over major parts of the food and beverage service. More toilets, vending machines and trolley transport systems are installed in the lower deck. A highly sophisticated virtual reality head sets environment is adjusting to the demands of the individual passenger and succeeds to shorten the subjective flight time.

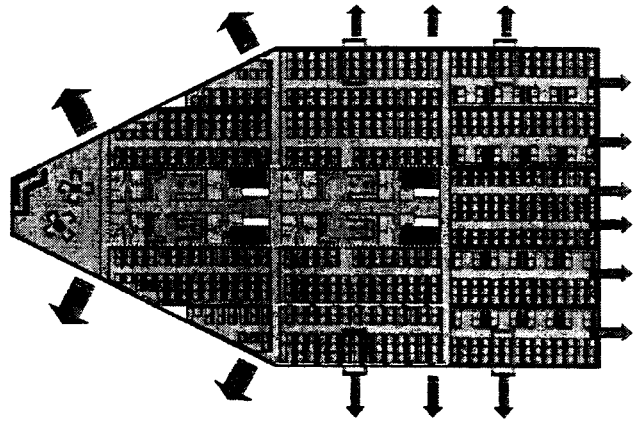

Figure 12: 2D layout with emergency exits

In case of emergency, in contradiction to current certification rules, wing emergency exits are blasted away after intelligent hazard detec-

tion systems decided the safest way of evacuation. If necessary, the big tail doors are opened to quickly leave the plane. Some views of the cabin are sketched hereunder.

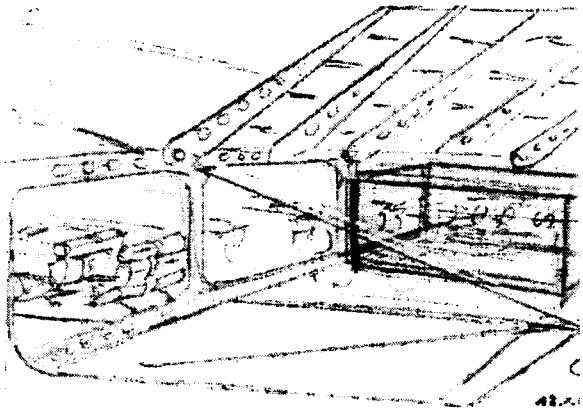

Figure 13: 3D sketch of tail container loading

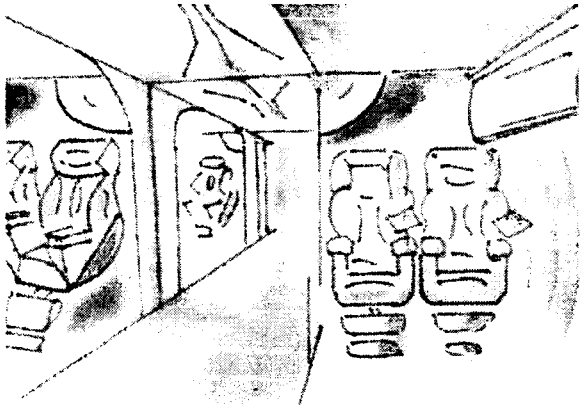

Figure 14: 3D sketch of container interior design

Evaluation of requirements

The different scenarios developed a range of specific requirements towards the cabin layout as well as primary cabin systems. To evaluate the robustness of these, they have been incorporated in all the three scenarios and controlled for their fit. The main results of identified robust layout requirements as well as primary technologies, which have not been discussed extensively here, are listed below:

- Increase in seat pitch despite the fact that adjustments are a matter of airlines
- Broader aisles are required which will define cabin layouts significantly
- Development of enhanced boarding and seat allocation systems with intelligent passenger flow control
- Utilization of the lower deck area: a major success driver, dependent on how strict regulations towards passengers are in the future
- Wireless communication technologies inside the cabin (passenger on-board system)
- Lobbying for enhanced certification rules
- Alternative and decentralized on-board high power generation (e.g. fuel cells) for a more electrical aircraft configuration
- Easy cleaning materials (similar to lotus flower effect)
- Recycling of operating supply items (water, oil, etc.)
- Computer aided direct view video system (passenger control during take-off and landing, monitor surveillance by crew)
- Intuitive emergency procedures
- Intelligent escape slides

Conclusions

With the help of scenario methodologies a consistent and structured approach towards the derivation of cabin requirements has been found, adopted and validated through three scenario specific independent cabin concepts. The compliance with economic, socio-cultural and technologic objectives has been a premise throughout the process, leading to different cabin layouts and models driving future designs. In a final step, robust requirements have been formulated by qualitatively evaluating the scenario fit evolving from the respective future environments. With the proposed methodology, strategic recommendations for the aircraft manufacturer are presented which can be adopted for other BWB configurations as well.

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FUTURE SCENARIOS FOR THE EUROPEAN AIRLINE INDUSTRY: A MARKETING-BASED PERSPECTIVE.

By David Jarach[1]

1. Abstract

The last couple of years have proven to be very tough for the airline industry. Macroeconomic turmoils, like Sept.11 attacks, consequent economic recession, the threat of terrorism and the SARS virus have all been having a combined drastic effect on both volumes and values of traffic performed by the industry. Microeconomic and industry-related changes, most definitively the dramatic growth of market power of low-cost carriers, are haloing this condition of contestability of the airline environment, putting into deep crisis incumbents' traditional business models and giving life to liquidity losses, huge deficits and bankrupts.

In the US market, LCCs have been a reality since the early '70s and have been counterattacked many times, with scarse luck, by incumbent network carriers.

In the European environment, instead, LCCs' attack is fresher and the ultimate answers by national carriers are still to be put into practice. The risks of inaction, however, are probably stronger than in the US, due to the higher fragmentation of the European industry and the States' ownership of many carriers that still prevent radically invasive market reactions, like mergers.

After an introductory but compulsory parenthesis on the rise of the low-cost phenomenon in the airline industry, this paper aims to analyse the new market scenario for the airline industry, focusing on the European context. Furthermore, the paper will analyse the main marketing tactics UE carriers might adopt to cope with the huge wave of low-cost entities and survive in the current tough environment.

Key words: airline industry, European airline industry, low-cost carriers, airline marketing tactics, aviation marketing.

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2. Changing the rules of the game: the new hypercompetitive contest for airlines and the rise of low-cost carriers.

Since the 70s, traditional market leaders in industry after industry, saddled with complex, high-cost business models, have been under attack by companies with new, simpler ways to manage their operations and contain costs. This scenario occurred in the steel industry, when minimills took on traditional smelters; in automobile manufacturing, when more standardized Japanese cars won out over customised U.S. vehicles; in retailing, when superstores overtook conventional grocery stores (Hansson, Ringbeck and Franke, 2002); and, eventually, in fixed telecommunications. The concept of value migration best describes the flow of profit and shareholders' wealth across the business chessboard. Value leaves economically obsolete designs and flows to reinforce new business designs, that are capable of creating equal, if not an increasing, utility for the customer and capture value for the producer. This situation also explains why firms with similar product or service offerings, as it is in the broad environment of commodities, can produce significantly variant economic performances. (Slywotzky, 1995).

In the case of airlines, the demise of tight regulation and the consequent rise of hypercompetition have brought an abrupt end to the age of chivarly for this mature industry. In other words, within a short amount of time, historical rather than forced cooperation and chivarly have been cancelled as business pillars. The erosion of monopolies and oligopolies by means of new start-up value propositions, first in the US and later in Europe, has dramatically changed the codes of competitive conduct and radically altered the customer's perception of the airline service, too. In other words, the gentility of tacit collusion and avoiding head-on competition, which were tipically working in the regulated era, are now gone (D'Aveni, 1995), with mature airline service rapidly moving from value-added experience to pure commodity. This shift in the definition of competition has been relatively rapid and was largely unexpected even to the deregulation's advocates.

Waves of new carriers jumped, and later abandoned, notwithstanding the political exit barriers that the industry faces, deregulated environments. In the US, first, and later on alla round the globe, a new category killer entered the market scene. Low-Cost Carriers (LCCs) provided a new, semplified value proposition to a wider market potential and rapidly acquired huge numbers of customers. The challenge, from that time on, would have been for traditional carriers to cope with this apparently perfect and superior economic travel formula.

2. Traditional airlines vs. Low-cost carriers.

In fact, what has been a tough challenge since the early beginnings for network-based, traditional operators in the fight with LCCs is basically the confrontation between two radically different business models. The formers' one is based on a calm, oligopolistic market aimed to support the idea of global coverage of the entire world

arena. The latters' one, instead, is only apparently focused on a more niche oriented approach. In fact, it is aimed at getting benefit from offer vacuums and from the service of "pariah customers", starting from VFR, ethnic and leisure based movements and later on climbing up to reach cost-conscious business travellers. Tables 1 and 2 sum up the main differences in the market approach of network-based and low-cost carriers.

Table 1 – The pillars of network-based airlines.

⇒	Massive marketing expences (advertising, FFPs, travel agents' overrrides, network analysis);
⇒	Expensive, fragmented and complex service (classes of tariffs and service, catering, lounges, ground services, etc.);
⇒	Massive use of technology (hard tech: aircraft tailored for each route and prescription; soft tech: CRS legacy systems);
⇒	"Ancien-regime" financial targets (in contrast with macroeconomic shockwaves and lifestyle changes);

Table 2 – The pillars of low-cost airlines.

⇒	Minimal marketing expences (word-of-mouth on comparative advertising, airports' supports);
⇒	Personal, convenient and pleasant service (reengineering around core benefit, easy price discrimination);
⇒	Judicious use of technology (hard tech: fleet standardisation; soft tech: Internet and CRS avoidance);
⇒	Structural efficiencies (no overstaffing, high productivity, no hubbing costs);
⇒	Realistic financial targets (based on their own business model);

In fact, some of the basic advantages of LCCs are apparently quite obvious and are certainly all but not industry-specific. For instance, part of a better cost management process can be easily correlated to the fresh market entry and, thus, to highly efficient hiring and salary practices for both HQ staffs and crews. Another benefit, most definitively in the European context, may be linked to some form of comparate advantages, like in the case of a more favourable fiscal legislation providing tax incentives for local operators. For instance, Ryanair is registered in Ireland, where corporate taxes are far more lower than in other countries of the continent, like Belgium. Eventually, effective B2B tariff negotiations that many LCCs are able to perform[2] are simply a consequence of airports' vulnerability, due to the absence of a clear airport marketing activity[3] (Jarach, 2002). In fact, in every industry facing power imbalances in pipeline relationships (Jarach, 2001), opportunistic behaviours by channel leaders are in practice to exploit the power imbalance of the counterpart, typically in the form of huge discounts.

This said, evidence shows that for some part LCCs' healthy cost condition could also be apparently matched by traditional incumbents even through isolated[4] tentatives of xeroxing some of the formers' elements. For instance, a narrower cost imbalance could also be obtained by sporadic rather than cosmetic measures, like firing off personnel and hiring it back at lower salaries, as the Swissair-Swiss conduct *docet*. Or through the creation of an Irish subsidiary that is being responsibile for all aircatf purchases and leasing transactions, for instance. Most of the other elements of the LCCs' formula, however, seem to request a much more radically deeper reengineering of the entire value proposition and are not definitively sensitive only to *una-tantum* actions.

The fact is that you don't need to be a start-up to build a business model focused on a previously ignored market, but it helps. Established companies have great difficulty seeing how unprofitable segments can be served profitably, particularly if those established companies have been very successful. That's because their own success blinds them to opportunities right in front of them, in sort of business myopia. For example, try to put yourself in the shoes of the executives who ran the dominant airline of the 1970s and 1980s and watched a struggling Southwest Airlines try to get off the ground. With the failures of discount carriers People Express and Laker Airways making headlines, would you have believed that another cut-rate US airline would survive, much less become the most profitable carrier? (Rosemblum, Tomlison, Scott, 2003).

3. The challenge at our days.

Coming to nowadays situation, world's major traditional carriers are being faced with some of the worst rather than hardest and unpredictable challenges in the "rules of

[2] Frequently in the form of huge subsidies for start-up and expansion of low-cost operations

[3] This means the absence of a clear airport market positioning and, consequently, no airport marketing plan.

[4] This means that these measures are not coordinated and integrated inside a strategic business plan or reengineering platform.

the game" of their market environment since the first Wright Brothers' flight at Kitty Hawk just 100 years ago. For instance, US carriers alone lost more than $10 billion in 2002, according to the Air Transport Association, up from the $8 billion in the disastrous year of 2001. While, more generally speaking, worldwide airline losses topped $50 billion in 2002. These tragic figures necessarily ask for a deep analysis and request to understand all the real causes, distinguishing the cyclically-correlated from the structural ones.

The traditional carriers' business model has been a great success and a major innovation when looking back at the early '90s, but today it is showing to be no more substainable in the current form. Strictly tied to massive physical infrastructures, diverse and unconsistent fleets of aircraft, legacy information systems and large labor pools, traditional airlines are today struggling to give even a medium-term perspective to their existence on the market. Most definitively, what seems today highly debilitating for traditional carriers is their inability to overcome their cost burdens with boom period pricing, as they did in the second half of the 1990s. From one side, post-Sept.11 economic *de-facto*[5] recession and the inherent constant terrorist threat, with the adding of the Second Gulf War, are still keeping away vast amount of passengers from woldwide carriers. From the other side, the recent SARS world health alarm and the consequent travel warnings and bans by WHO for China, Hong Kong, Singapore and Taiwan has sinply cancelled for a number of months the Far East arena as an air travel destination for both business and leisure traffics, with major airlines implementing up to 90% capacity cuts on the previous flown hours to the area. As a parallel consequence, these macroeconomic events are accelerating the pace of diffusion of videoconferences as a more than rather perfect substitute of the flight experience. This is another clear signal that these external shocks won't be absorbed by carriers with the same substantial inaction performed during the previous cyclical crisis.

On a microeconomic, industry-related focus, instead, this tough airline environment is proving to be apparently much more healthier for LCCs, that are dramatically increasing their own market shares on a worldwide basis. What can be highly surprising for non-industry analysts finds, instead, rather simple, non-technical explanations. For instance, sales figures[6] prove that SARS and threat of terrorism are still preventing long-haul travels, most definitively in the case of "highly-sensibile", risky destinations, like China, Canada or the Middle-East. On the contrary, this negative effect is much less in the case of short-haul flights[7], where safer trips are involved and where tariff stimulation[8] may push tourists and business men to abandon personal or company flight bans.

The impact of both these macro and microeconomic turmoils on technical indexes for IATA actors has been quite immediate. Traditional carriers are being faced a significant yield diluition with a steeper-than-forecasted curve, well over the 2-3% decline recorded on a year-round base in the last decade. This condition finds

[5] Generally speaking, economic macroindicators don't reflect on a worldwide basis a situation of recession. However, it's vastly accepted that the terrorisk attacks create uncertainty conditions for the market, and this blocks long-term investments.

[6] Provided by IATA and American Express, for instance.

[7] These sales figures don't contemplate the two weeks immediate post the Twin-Towers' collapse.

[8] This situation can be easily explained by thinking to the negative demand to price elasticity that now is starting to affect even business travel, with budget cuts reducing movements or shifting them to LCCs.

quantitatively evidence in the fact that CASM[9] run well over RASM[10], this gap already reaching 2 cents per seat mile at the beginning of 2002 in the US (Hansson, Ringbeck and Franke, 2002). In a condition of fixed-costs that reach up to 90% of total costs and with few chances of cutting them in the short period, this revenue-cost imbalance naturally gives life to huge deficits, liquidity crises, job cuts, network reductions and, eventually, bankrupts. This was the case in North America for Chapter 11 filings of USAirways, United Airlines, Hawaiian Airlines and Air Canada. Or in Europe for the bankruptcy of Swissair and Sabena, where these companies failed and entered again the arena basically only with a different brand, but taking on the same historical and structural weaknesses, in what could be described as a sort of European answer to the US Chapter 11 instrument.

Thus, in order to survive, major airlines have no choice but to change their course, modifying their rigid business model to better match the challenge by LCCs. Although making fundamental changes in a long-standing business model is difficulty and risky, it is not without precedents, like it happened, for instance, in the manufacturing and financial services contexts. And, by far, the risk of inaction is much more greater than the risk to change and the difficulty to find a new working business path.

4. The European business case.

In the EU environment, the late '80s airline deregulation process has pushed in dozens of start-up new entries and, consequently, fierce price competition on many ruote legs. This condition has progressively pushed many former flag carriers into deep competitive and financial crises, as their cost structures were based on the previous oligopolistic regime and, thus, no more consistent with new hypercompetitive pattern of action.

A major difference with the US environment, however, lies in the fact that Europe hasn't recorded any significant capacity exit from the industry, as the above described Swissair-Sabena cases clearly evidence. On the contrary, recent announces once again demonstrate that the "one country, one flag carrier" model is still working, but no more achievable, especially in the case of small countries with a limited Origin/Destination demand[11]. No consolidation practices have taken place, if we exclude some small regionals and the notable exceptions of Ryanair-Buzz and Easyjet-Go in the low-cost cluster. According to pure economic figures, no more than 4 nationals and 20 regional carriers should act in the EU environment. Notwithstanding this, we still have 20 medium-shaped airlines and more than 50 regionals working, a figure that is continually increasing.

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[9] CASM is the acronym for Cost per Average Seat Mile.

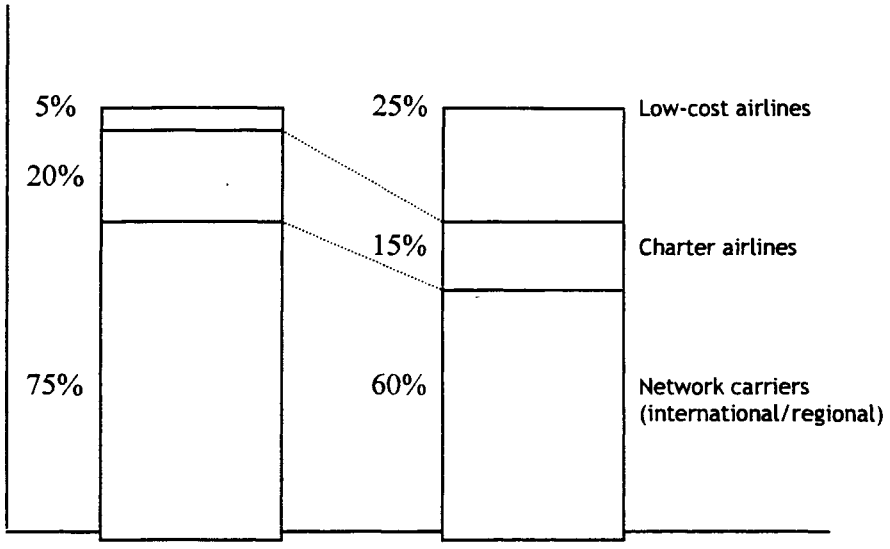
[10] RASM is the acronym for Revenue per Average Seat Mile.

[11] Swiss, the Switzerland's national carrier, is probably the best example. But the same condition can be applied also in the case of Holland, Austrai, Portugal and Greece, for instance, where global ambitions of local carriers have necessarily lowered by the state-of-the-art market conditions.

This high level of fragmentation, which many times has only an apparent basis in ASAs' ownership clauses, is reflected in the relatively low market force each major can deploy in the confrontation with large US trunks and, definitively, with LCCs. While alliances have been a good solution for entering close markets or partly increasing revenues, they have actually failed in the goal of reaching a higher cost efficiency. In this sense, we can say that till now partnerships have only marginally impacted on the cronical economic and cost vulnerabilities of EU carriers.

This elements help to better explain why LCCs have really boomed for the last couple of years in the continental context. Recent post-Sept11 updated statistics reveal that European LCCs are expected to account for up to 25 percent of the market by 2010, following the same path of market expansion that is taking part in the USA, where some analysts predict thet LCCs could reach up to 70% of domestic services. Figure 1 shows the current and the expected market condition in the European airline industry.

Figure 1 – Projected change in Intra-European Passenger Market Shares, 2000-2010.



Source: AEA, IATA, Mercer

Today, Ryanair, Easyjet, Germanwings, Hapag Llyod Express and other European low-cost entities are abandoning their traditional British focus to explore other huge continental catchment areas in Germany, France and Italy. Acting as flexibile, dynamic and innovative plyers, they are eroding the advantages of network airlines and making healthy profits. Or, when not yet profitable, they are consolidating market shares to build a greater critical mass or a slot dominance on key airports[12].

The real strategic ultimate issue for European traditional carriers, however, is that they are not facing a unique and standardised low-cost business model, as a sort of

[12] As in the Easyjet-Paris Orly tentative, or in the Ryanair-Stansted or Easyjet-Luton cases.

European adaptation of the original "no-frills" American formula has taken place. Some LCCs, for instance, are considered pure "Southwest clones" and focus primarily on VFR and ethnic traffic: Ryanair is the best example. Others, like Easyjet, have had since the beginning a different focus, aiming at capturing cost-conscious business travellers, and probably are the real top danger for traditional operators.

In this sense, time for change has come: major carriers have to choose between one, or a combination, of six possible counterreactive market strategies to cope with LCCs. These tactics can be equally implemented in all market scenarios where traditional carriers are being touched by the LC formula. Thus, they can equally work, if not already in place, in the US, European or Asian environments. The pace of introduction of these market reactions, however, is much more urgent in Europe, where the threat is fresher but blocked past conditions have created airline structures that must compulsorily be changed in the short-time. In other words, this goal has to be rapidly implemented, if the European industry would really aim to play a role on the world scenario in the next ten years[13].

4. Six market strategies for traditional carriers to counterreact LCCs.

On the basis of what previously said, European traditional airlines have to choose not only on which part of the battlefield stay, but also which kind of market tactics use to cope with the New Millenium challenges.

Although some academics predict that there will soon be only low-cost operators for all markets, even long-haul ones, we don't believe so. Chances for most of today's traditional carriers to survive, however, lie in a rapid adoption of one or a proactive combination of of the following six counterreactive tactics.

a) Resist. This option is the most conservative a traditional carrier may implement. The basis for this choice logically lies in the perception that LCCs are simply waving a fashion-effect and that, sooner or later, they will be abandoned by frustrated passengers coming back to higher price/comfort combination. As a consequence, a traditional carrier will continue to replicate its consolidated pattern of offer, eventually modifying only its own timetable with the aim of braketing the LC offer, for instance.

As to substain this thought, airline managers frequently come to a comparison between their own industry and what happened, for instance, some years ago in the retailing arena. In the latter's case, hard discounts were experiencing a rapid massive growth, too. In the long-term, however, their market power was sometimes deeply marginalised, like it was for the Italian context. In other words, airline managers' belief

[13] It's important to underline that LCCs are beneficial to customers, thanks to their low tariffs. But, at the same time, their pressure on incumbent traditional players forces naturally the latters to streamline, abandoning for instance unprofitable routes. This means that competition between system of countries can be affected, too, not forgetting that carriers are the logical connectors of globalisation drivers and fluxes for goods and people.

lies on the basis that passengers are only migrating to LCCs on the basis of a short-term "cherry-picking" effect, just with the curiosity to try a rather innovative value proposition, but with no risks of arising loyalty effects to it. According to this thesis, these kind of customers will, in fact, come back to what basically is believed to a better service in absolute terms and thus for all markets and people, as no changes in the lifestyles or in the purchase priorities of the airline service are involved.

Errors lying behind this approach are clear. First, market segmentation postulates that customers are naturally different in their value perceptions and conceives that some people could easily become loyal to the "no-frills formula", if this one better suits with their perceived value[14]. Second, huge price gaps provided by direct competition on the same routes and airports, like in the case of confrontation between a traditional carrier and hybrid LCCs, will naturally support the choice to switch to the cheaper alternative. This condition will likely have a broader impact on customers' travel lifestyles and will progressively marginalise traditional carriers from the profit zone of the market. The traditional airline will then be forced to change its approach and pass to the "retrench option".

In this sense, the only real way to maintain the market *status quo* for a traditional carrier is through State supports in the form of subsidies or rigid slot allocations that prevent LCCs from entering the former's national skies. The recent slot lottery at Paris Orly after the bankrupt of Air Lib Express is frequently mentioned by Easyjet as a clear protectionist attitude by the French authorities to Air France.

b) Adapt. This option is, again, one of the least invasive, either from a political and a financial point of view. It aims to reach a minor impact on flight operations, but certainly not a deep reengineering of any structural value-chain processes. In this condition, airlines will act to adapt their own business model to that of LCCs by means of a "copy" strategy, with the goal of integrating in its own servuction (Eiglier and Langeard, 1983) the simplest elements of the latters' design. The return to point-to-point service focus[15], for instance, is applied by the traditional carrier throught lowering waves-based network interrelations in the form of more viable "rolling hub" concepts. This option is being implemented by American Airlines and is dramatically improving the company's productivity levels, while offering at the same time a chance to better serve lucrative O/D traffics and abandon part of uneconomical connecting fluxes.

Moreover, a reduction of in-flight catering frills may have a positive impact not only in the form of lowering direct costs, but also permitting to leave off galleys from aircraft interiors, with a chance of improving seating figures for the aircraft. This option is being undergone in Europe by Lufthansa, Alitalia and Swiss[16] and probably offers the most apparent cost reliefs to tradtional carriers.

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[14] The perceived value is the ratio between the benefits a service and a brand can better offer to customers divided for the sacrifices a customer has to substain for entering in possession of this benefit.

[15] Historically, we can say that traditional carriers had been tighly focused on point-to-point traffic. Deregulation provided the need to develop hub-and-spokes networks.

[16] The three carriers are actually following different approches on this matter. Luftahnsa is cutting doemstic catering as to lay off galley to obtain a seating improvement. Alitalia recently tried to cut its domestic catering with the goal of reducing the number of cabin crews, matched with the elimination of seats as to comply with ICAO rules. Swiss recently decided to suspend free-of-charge catering in economy class, following a similar approach to that of LCCs.

c) Retrench. Back in the '80s, when facing a calmer market environment and basically a form of non-price competition, traditional carriers started to increase the scope and variety of their products by layering on new offerings to serve even larger and more diverse customer bases. This differentation process faces a natural crisis when markets become mature and overcapacity forces to act on price cuts to retain demand. In mature markets simplicity, not complexity seems to pay off when fighting for the supremacy of its own value proposition.

In this sense, failure in facing the LCCs' attack and in scouting new anelastic clusters takes the traditional carrier to retrench. This process is being implemented by means of job cuts, network streamlinings and capacity reductions. Each one of these three alternatives has clear pros, but a number of cons can equally arise.

Job-cutting measures, for instance, dramatically benefit the P/L accounts of what is still a labour-intensive industry. However, the frequent risk is that they can be really implemented only after tight confrontations with unions and after a number of strikes would have significantly damaged the carrier's image and reputation. This is why, under a purely financial metric, a long-term relevant benefit has to be actually discounted by subtracting lost sales and image and reputation damages[17]. By quantifying all these elements, some of them with clear psycological impact, it looks like job cuts have frequently proven to be only a panacea for the carrier, while not solving structural issues. A "cosmetic" solution to the problem of overstaffing can be achieved by firing off less unionised categories, like HQ staffs, or by imposing them corporative salary reductions in exchange for job maintainment. A similar experiment was conducted by Alitalia case, but this option hasn't actually proved a real good bargain for the company[18].

Network streamlining focuses on harvesting losses by cancelling unprofitable routes. Traditional carriers, when following this approach, usually decide to act first on long-haul destinations, due to the combination of high operating costs and inefficiences in their price structures[19]. A narrower scope of action for a traditional airline, however, impacts dramatically on its own distinctive visibility, as network contraction actually reduces the hub-based, global carrier's attractiveness and seriously compromises its marketing promise of a seamless service to wherever.

Overall or route-focused capacity reduction, instead, may prove to be the best of the three alternatives. By phasing out current planes and trading them with smaller ones, airlines can better match demand in off-peak periods or on highly-contestable routes, this implying simpler yield management practices, too. This option can be implemented statically by simply exchanging old planes with new smaller ones[20], or dinamically by combining for every route the capacity of different aircraft of the same family, as it

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[17] The result can be achieving by using this formula:
Long-term cost benefit = Cost saving from salaries – lost sales (t to t+1) – reputation damages (t + t+1) – loss of motivation

[18] Unfortunately, however, cost drivers for a carrier lie in the unionised crews, not in the backoffice

[19] The current pricing philosophy in the airline business asks carriers to hugely discriminate their own tariffs as to satisfy all clusters. On long-haul routes, hugely discounted prices are used to attract tourist traffic. These tariffs, like APEX or PEX, seldom cover the per-capite cost of the flight, especially in the case of highly inefficient operators.

[20] This is currently the case of USAirways, that is phasing out F100 and some B737s and substituting them with smaller RJs from Bombardier and Embraer.

works in the Airbus A318, A319, A320 and A321 case. This tactic would naturally drive LCCs to become volume leaders on trunk routes, with traditional carriers abandoning their anacronistic market share targets and refocusing on net present value upgrades. This approach is being implemented by British Airways, which has been hardly touched by LCCs after it lost in a couple of years some 15% of the all intra-European O/D traffic.

d) Fight. The "fight option" asks for the traditional carrier to go head-to-head with the LCC by almost entirely matching its tariff policy. Vast amount of managerial literature illustrates the risks of a price war contest and how this risky decision should be taken only when a solid cost advantage is detained. This is definitively not the case for all traditional carriers. These elements help to understand why[21] fare wars usually take place not only in the first periods of LCCs' market entry, but also a route-by-route basis and with the clear aim of avoiding halo consequences on the rest of the traditional airline's markets[22]. However, there's also empirical evidence of a longer, more subtle, form of price war between the incumbent and the new entrant. This kind of alternative works when the traditional carrier is strongly attacked by the LCC in the former's domestic market. In this case, the "fight option" is also done by means of some indirect pricing tactics. A typical example is provided by the tactic of increasing commissions paid by travel agents as to block access to trade and increase the distorsion power the agent can have on customers' purchase decisions (Jarach, 2002).

By xeroxing the LCC's pricing, a traditional operator basically tries to defend its volume market share and to discourage the new entrant from further invasion plans. This option seems, however, inconsistent in its own bases, because traditional, high-cost carriers should target high-yield traffic while not focusing their attention on load factors only, and consequently on low-yield, ethnic traffic, for instance.

e) Join. The "join option" requests traditional carriers to enter directly the LC cluster with an identical business design. This can apparently take place in two different ways.

The first one is the creation of a low-cost subsidiary by traditional carriers. This alternative will prove to pay off its best results if the airline is really able to rigidly split business traffic and leisure and VFR movements, the former being allocated to the maintrunk carrier and the latter to the LC subsidiary. Apart from this theorical optimum goal, this kind of product diversification practically works in the form that the LC subsidiary becomes responsibile of all highly contestable routes where price cuts can be substained only by a similar cost structure of that of the attacking LCC.

This case was first provided by the US enviroment in the early '90s, with United giving life to Shuttle, USAirways creating Metrojet, Continental spin-offing Continental Lite and Delta with Delta Express[23]. Recently, European carriers also decided to jump

[21] Back in the '80s, instead, tariff confrontation was performed on a national basis, as the US market has taught.

[22] A typical example is provided by the Delta-AirTran case on some domestic routes out of Atlanta. In Europe, there is similar evidence on some routes to and from London.

[23] Delta Airlines have just starter up a new low-cost subsidiary, called Song. This entity, however, is much more a JetBlue rather than a Southwest clone, operating from the same markets and targeting cost-conscious business travellers, most definitively women. Delta Express, instead, was the hypercompetitive

in the LC arena, as in the British Airways/Go, SAS/Snowflakes, KLM/Basiq Air cases, or, indirectly, with Lufthansa and the Germanwings experiment[24]. Moreover, the European environment provides evidence of the emergence of charter carriers' low-cost subsidiaries, like Hapag Lloyd Express for TUI or MyTravel Lite for MyTravel.

The survival ratio for LC subsidiaries, however, shows that most of them have actually failed[25]. In fact, it proved very difficult to create internally, inside highly-unionised or rather conservative companies, the same entrepreneural spirit and the scope of salary concessions that are being obtained by genuine LC start-ups. On a broader view, we can say that mingling complex and simple operations, each of which has distinct objectives and missions, often increases costs and lowers service standards of the whole company. Once again, this can be considered not an industry-specific comment, but a broader-scale evidence.

The second option is provided by the transformation of the whole traditional carrier into a LCC. This path of action naturally fits better in the case of a regional carrier, as it was successfully implemented in the case of the British operator FlyBe. Matters of dimensions and a lower cost-per-seat gap justify this statement. For instance, in Italy there's speculation that Eurofly, a charter carrier with a minor stock participation of Alitalia, is going to undertake a radical change and enter and fight within the LC arena. Volare, another Italian regional and charter carrier, has also announced that from 2004 all of its services will be operated by Volareweb.com, the group's LC subsidiary.

In the case instead of the transformation of a national full-service operator into a LCC, as in the case of rumours around SAS, the task for management risks to be herculean. Unions and employess will be unwilling to accept a salary reduction, unless eventually in the form of an ESOP[26] program. But the passage in LC arena means that the traditional carrier will automatically leave most of its own operated long-haul network, too. This decision will crash against Governments' will to maintain an international visibily, with a participation in an umbrella alliance highly preferred to the probably much more revenue-generating LC option. Thus, many incumbent airlines will find really complex this transformation, with price-cutting measures becoming a short-term implementation and drastic cost reduction only a far mirage. No surprise that in the European low-cost environment we still find a lot of stuck-in-the-middle "low-fares, high-cost" airlines, like Meridiana in Italy, or the defunct Air Lib and Air Lib Express in France.

f) Ally. This could really become the next frontieer for the whole airline business. Till now, we have basically assisted, from one side, at LCCs' consolidation practices and,

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answer by Delta to the invasion of the Florida market by Southwest, which the former unseuccessfully tried to imitate in its own business model.

[24] Germanwings is the low-cost subsidiary of Eurowings. Lufthansa has some 25% of Eurowings share, with an agreement to grow up to 50%.

[25] This figure is related to the US market. European LC subsidiaries are very young, so it's too early to say that they are still on the market because of different conditions or because time still has to come even for them.

[26] Employee Stock Ownership Programs (ESOP) have been widely used in the '90s for obtaining salary concessions. Today, there is literature that evidences that ESOPs have only created greater governance problems for their companies.

from the other side, at alliances as indirect integration practices[27] for traditional carriers. Or, eventually, at the very expensive and rather unsuccessful "join option" in the form of start-up of a LC subsidiary by an established airline.

What we still haven't seen, however, is some sort of extensive contractual agreement between a traditional and a LC carrier, the only exception being the limited route-based, block-space agreement between Virgin Express and Sabena.

The advantages for both actors could be, instead, significant. The low-cost carrier could more easily grow in its target market. This process could be achieved by the help, and no more fight, of the home carrier, the latter supporting the former, for instance, in the PR activity or in the trade and commercial relationships.

The traditional airline could, instead, avoid a bloody fare war, preserving the value of its own scarse resouces by transferring its own capacity on those routes that cannot be served by LCCs: like in the case of regional-feeder services and long-haul routes[28]. In the highly contestable, trunk medium-haul services its commercial precence would be garanteed by block-space agreements, eventually, interlining those services with its own long-haul network[29].

Thus, as the process of market growth by LCCs continues, the "ally" option could be the most efficient and effective answer to cope with the changes of market boundaries without the need of burning, with apparently any tangible results, large amounts of cash.

The fact that these alliance patterns are still not in action has not to be only correlated with the will by LCCs to cherry pick all the possible customers in the growing phase of their product lifecycle. Once again, egotistic behavious by traditional carriers' top managers and their belief that LCCs are simply transitory within the airline business are the real technical and human explanations for this option not to take-off.

6. Conclusions

The darwinistic process that many industry observers have long predicted for the world airline industry hasn't still taken off, most definitively not in Europe. This aspect, when dealing with the European environment, is strictly linked with the clear protection that national countries still provide to their flag carriers, either as shareholders or simply as a matter of international pride. State aids, in the various forms, are still working, even

[27] The term "cosmetic" for alliances refers to the fact that the real goal that these agreements should reach, that is cost reduction, is well far from being achieved. Aspects like aircrafts' common procuments or other potential joint purchases (fule, insurance, handling, maintenance) are not touched by alliance paths. Only the simpler practice of revenue increase, basically through the old-style "code-sharing" formula, are really being implemented by partners. Once again, the nationalist ego of shareholders and top managers prevail on a rigid logic of asset maximisation.

[28] Feeder and regional services are typically thin markets, where capacity needed is not that of LCCs for achieving their break-even load factors. Long-haul services, on the other hand, are immune from LCCs because on a hours-long flight on-board comfort becomes a primary issue and even conscious passengers are uwilling to trade it for a low fare. For many routes, moreover, strict bilateral agreements and single-designation practices still protect the monopoly of traditional national carriers.

[29] Developing an on-line connection in the form of code-sharing between a traditional and a low-cost operator promises, instead, to be a very risky business. For instance, the superior quality image of the traditional operator could be diluited by the association with a low-cost operator.

if they had formally banned since the early '90s. It's certainly true that the conditions that all airlines has had to cope with for the last 2 years are not only traumatic, but totally unpredictable. Thus, many liquidity crises can be certainly related, at least partly, to these factors.

But, if the goal is to exit the current downturn cycle with a probably streamlined number of actors, but in fact with a stronger European industry, no more time has to be thrown away in the process of adapting traditional carriers' business pillars to current competition patterns. In the same time, the business model innovator will not stay still, but it will constantly work to figure out how it can do more for its customers. For example, reducing cost structures and passing on some of the savings to customers.

In this sense, every traditional carrier has to evolve into a new type of airline capable of being centered around these five pillars of action:

- ***Simple*** in its value proposition, with service diversity encouraged only when market needs ask for it, like in the long-haul sector;
- ***Committed*** in its endless effort of cost reductions, as the only way to survive in the market, due to yields' erosions;
- ***Proactive*** in its continued research of new cluster of demand to match with existing products;
- ***Consistent*** in its marketing approach, avoiding the temptation to raise short-term benefits in the form of lower prices for a lower service, for instance, whist privileging its own natural long-term view;
- ***Clear, transparent and effective*** when dealing with internal customers' relationships, as a labour-based service practice may only survive thanks to the consensus of its own employees.

We cannot say if Jan Carlzon's late '80s profecy, stating that only four traditional carriers would have survived in the New Millenium, is still alive. What is certainly true is that the European market may sustain a significant number of airlines, as it is today, only if they are internally consistent with the current scenario and with a clear elective positioning in mind. Exactly what is today missing to Europe's traditional carriers.

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The Dynamics of Multilateral Alliancing: A Process Perspective on Airline Alliance Groups

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Abstract

The proposed paper is a summary of a larger research project that was started in 1998 and that set out to contribute to the understanding of (a) the factors which shape the structuring of multilateral, horizontal alliances and (b) the implications for corporate governance of firms within such an alliancing environment. The paper argues that the positioning of an airline within an alliance group depends on the airline's resource configuration and is furthermore a function of environmental constraints 'forcing' certain types of airlines into certain choices; of conscious, 'rational' strategy devising; and of the degree to which alliance membership (or "alliancing" itself) gains institutional legitimacy. Because the organisational phenomenon under study can be understood as both a social and a technical phenomenon, the study uses a dual theoretical approach. On one hand, the positioning of airlines in the alliancing environment is examined using a resource dependence perspective. Introducing the terms 'standalone capability' and 'specific and unspecific dependence', the mitigation of power imbalances in a formal network of firms and the management of interdependencies between partners will be discussed. It will be suggested that the success of an airline within an alliance group depends on that airline's resource configuration and on its ability to position itself in the alliance network according to that configuration. In addition, it will be suggested that in a federated environment, partners fare best if they specialise.

The second perspective used is that of institutional theory. Based mainly on the interview material gathered, the aim is to identify the lines along which alliancing is becoming a part of actors' mindset, or the institutionalisation of allianc*ing*. Hence, this part deals with the 'invention' of alliances, in other words, how 'rationally devised' structures are enacted in practice. It introduces a concept called 'countervailing myths', which seems to be a prominent factor in the shaping of the institution 'alliance'. This second part is based on extensive interviews with senior management from ten different airlines.

The paper concludes with the discussion of a model depicting the factors that influence the development of multilateral alliances between autonomous, but interdependent firms, accounting for both "centripetal" forces (pushing toward tighter member integration) and "centrifugal" forces (pushing for looser coupling).

Keywords: Air Transport; Alliances; Resource Dependence; Institutional Theory

Introduction

Airline alliance groups are complex, heterarchical, and dynamic organisations that have no relevant precedent. Their complexity stems both from the dynamic aspect and from the fact that they are highly asymmetric and consist of multilateral links between autonomous or semi-autonomous partners. This means that to some extent, multilateral alliance groups can indeed be seen as organisations in their own right. However, it can be assumed that the force which drives, and shapes, such a type of organisation is not -as it would be in 'classical' organisations- a common purpose. Instead, it is interdependent needs. This study, then, looks at the multilateral alliance as a system of interdependencies. This interdependence of needs contains forces which both work toward greater coherence, or tighter coupling, of organisational actors, but also other forces which push them apart, and favour loose coupling. This paper is a summary of a larger research project (Kleymann, 2002) that was started in 1998 and that set out to contribute to the understanding of (a) the factors which shape the structuring of multilateral, horizontal alliances, and (b) the implications for corporate governance of firms within such an environment. The study was based on the assumption that the positioning of an airline within an alliance group depends on the airline's resource configuration and is furthermore a function of environmental constraints 'forcing' certain types of airlines into certain choices; of conscious, 'rational' strategy devising; and of the degree to which alliance membership (or "alliancing" itself) gains institutional legitimacy.

The study used the inductive theory building method (Glaser and Strauss, 1967; Das, 1983; Martin and Turner, 1986; Eisenhardt, 1989; Isabella, 1990; Pettigrew, 1990; Daft and Buenger, 1991; Burrell and Morgan, 1997; Locke, 2001) to build a mid-range theory (Pinder and Moore, 1980) of the dynamics of multilateral alliances. It accommodates research methods such as participant observation, interviews, and the collection of different types of data over a certain time span, in an attempt to understand the factors affecting the emergence of this phenomenon.

This paper is structured as follows: First a justification for the use of a dual theoretical approach is given. Then, the alliancing phenomenon is discussed from a resource dependence perspective, the first of the two suggested approaches. After that, the

institutionalist perspective is applied to interview material gathered during the research process, to help understand the behavioural aspects of alliancing. The third part of this paper will then combine these two perspectives and try to depict a schema of alliancing dynamics in the airline industry.

A dual theoretical approach

Alliancing "happens" at several levels; at inter- organisational level, firms position themselves in networks according to their resources and needs; at the level of interaction between individuals, airline managers "invent" the alliance group, and it is their negotiations- and their joint sensemaking of a unique situation- which shapes the alliance as an organisation. It is suggested here that one potentially rewarding avenue to follow when trying to comprehend alliancing dynamics is a combination of macro- and micro-processual perspectives. These perspectives need to be conceptually linkable to each other by meeting the following two core requirements:

1. One core requirement for these perspectives is that they allow the accommodation of views that go beyond (but do not fully exclude) the 'classical' assumptions of efficiency- seeking, profit- optimising behaviour, *both on organisational and on individual level.* The present study assumes that at individual (and micro-processual) level, what is considered 'rational actions' is a function of 'local' rationalities. Thus, the individuals' and organisations' perceptions of what may constitute a 'rational' action may indeed vary. At organisational (macro- processual) level, the assumption is that organisations are evolving, deploying primarily local responses (especially in the present case of the airline industry where there is no organisational blueprint for the development of multilateral alliances), and that the *primary* aims of the organisation's responses are not so much directed at profit-maximising goals, but rather at the preservation of itself, or survival (see e.g. Stacey, 2000; Stacey et al, 2000, pp. 7-8)[1]. This does not deny the existence of profit- maximising rationales within a firm. It merely subordinates these rationales to the overarching meta-

[1] in fact, Stacey et al separate survival as a final aim from identity preservation (*"...interaction in nature takes place not primarily in order to survive but as the creative expression of identity*"). The present study, in contrast, assumes that identity protection is indeed the primary *manifestation* of the overall ambition to survive.

rationale of identity preservation, and ultimately of survival, both at individual and organisational level.

2. A second core requirement is that the perspectives used can help to understand the airline alliance as a "negotiated environment" (Cyert and March, 1992). They thus need to take into account the environmental uncertainties that drive firms to create negotiated environments in the first place, but also the uncertainties inherent in the negotiated environment itself. They also need to take into account the 'negotiation process' of the environment - this negotiation can be thought of as happening both on inter-firm as well as on intra-firm (i.e., individual actor) level. In the words of Doz and Prahalad (1993): "*Formal structure in an organization (organization structure) is nothing more than a shorthand way of capturing the underlying subprocesses: managers' mindsets* [...], *a consensus on strategy, and power to allocate resources consistent with strategy.*" Hence, an attempt must be made to capture the interrelation between 'negotiation' and structures, and to conceive the organisation as both a technical and as a social phenomenon (Westney, 1993).

The present study proposes that a fruitful line of inquiry against this background would be a combination of the resource dependence perspective (RDP) and institutional theory. Assuming a resource dependence perspective on alliancing is considered useful in that it (a) allows for environmental uncertainty, (b) can explain managerial preferences in terms of 'rational' actions aimed at a 'long-term' strategy, while (c) offering a link to other, more 'local' rationales (for example, seeking legitimacy in front of certain stakeholders). This link is taken up by the institutional perspective which is useful in that it is informed by the micro- processual level of sensemaking[2], sensegiving, and 'local responses'. These responses, in turn, can be assumed to be shaped or at least influenced by the actors' perceptions of dependencies (Van de Ven and Walker, 1984). Previously, the conceptual link between RDP and the institutionalist perspective has mainly been found at the level of legitimacy: i.e., institutional legitimacy as a resource. This study, however, seeks to show that there are further links between the two perspectives, especially in the sense that both institutional processes and resource dependencies can create forces that act on the

[2] Weick (1995:36) considers sensemaking to be "the feedstock for institutionalisation".

alliancing process, both in a positive (tie- strengthening) and in a negative (tie- loosening) way. Another conceptual link can be found in the mutual reinforcement of these two types of process. Oliver (1997) has combined the resource- based view with institutional theory to claim that in order to reach sustainable competitive advantage, a firm must manage both its resource base and the institutional context in which resource deployments are made. This study takes up this combination by (1) adding a "dynamic" view on institutions, i.e. by depicting how institutions emerge, also in function of resource interdependencies within the firm's task environment, (2) by illustrating the mutual bearing strategies of resource deployment and the firm's institutional context have on each other, and (3) by showing how the interaction of resource interdependencies and institutional contexts can shape the way an entire industry evolves.

Empirical Data

Empirical data were gathered from several classes of sources to provide various perspectives on airline alliances. In order to keep the population as homogeneous as possible, the investigation focused on small- to medium sized, internationally operating airlines, all of which are involved in alliancing. In order to provide a contrast and to describe the airlines' operating environment, additional material on larger, 'dominant' airlines was also collected. The sources of empirical data can be classified as follows

a) Press. This includes articles from both the specialised aviation press as well as general newspapers. A total of four airline business-related publications and three aviation online news services were monitored, covering a time span from January 1995 to at least December 2001. In addition, three business oriented general newspapers' online archives were examined. The "press" category only includes material written by third parties (i.e., 'outsider' journalists and industry observers). Press releases and press interviews given by airline executives were grouped under category (b).
b) Public Relations. This refers to material issued directly by the airlines, and which was destined to the public and the financial community. It includes press releases, statements made in annual reports (the annual reports of 14 airlines between 1993 and 2000 were examined), and statements made by airline managers in press interviews.

c) Senior Management (C.E.O. to Vice-President levels). Total of thirteen interviews with ten interview partners (one informant was interviewed twice, another three times). They represented eight different airlines. The interviews lasted between 45 minutes and two hours. The interviews were taped and later transcribed verbatim (fully or in excerpts); two informants asked not to have their answers tape-recorded, but notes were taken. The interviews were taken either at the interviewee's location, or over the telephone. In addition, a number of informal discussions (not taped) and e-mail exchanges took place with some interview partners from this category.

d) Middle Management and Supervisors. Nine interviews with seven interview partners (two were interviewed twice), representing three different airlines. Each interview partner had been or was currently involved in alliance coordination activities with partner airlines. They lasted from 45 minutes to just over two hours. Eight were taped and excerpts transcribed verbatim; one interview was conducted via electronic mail. Interviews were held either at a conference venue, or at the interviewee's workplace.

e) Front-line staff (Ramp Operations, Check-In, Passenger Services). Nine interviews (all from one airline), lasting around 30 minutes each. They were held at the interviewee's workplace. They were tape recorded and excerpts were transcribed verbatim.

The 26 interview partners (who all had a minimum of five years experience with their respective company) represent nine different airlines. Eight of these airlines are located in Europe; one in a relatively wealthy and politically stable country in South America. The interviews were conducted in a semi-structured way. Interviewees were asked to talk about the alliance-related events that affected their company and their own work (e.g. Das, 1983). Since one purpose of the interviews was to filter out key themes, the interviewer refrained from addressing any specific topics, and instead asked the interviewees to elaborate on subjects that they themselves had brought up. In most cases, the interviews turned into somewhat amicable 'shop talk', with interviewees being fairly relaxed, talkative, and willing to express their own opinions and concerns, albeit frequently with the caveat to the interviewer that a certain statement would be "off the record". In some cases, the formal interviews led to further correspondence by electronic mail or follow-up meetings. In the cases where the same person was interviewed more

than once (with a time distance ranging from two weeks to eight months), the second (and in one case third) interview was aimed at specific questions; that is, the interviewer asked the informant about specific themes, or recent events in the industry.

Part One: A resource (inter-) dependence perspective on airline alliances

The resource dependence approach can be seen as a development of the broader resource-based view, which conceptualises the firm as the holder of a set of resources (see e.g. Penrose, 1959; Wernerfelt, 1984; Conner, 1991; Grant, 1991; Mahoney and Pandian, 1992; Monteverde, 1997 and especially the recent discussion by Barney, 2001 and Priem and Butler, 2001 a/b). Departing from an open-systems view of the organisation (Scott, 1991), the resource dependence perspective in particular assumes environmental uncertainty and scarcity of resources and supposes that managerial action is directed at protecting organisations from dependencies that come about from the external environment. Resources and capabilities thus constitute an important determinant of direction and possibilities for the firm (Wernerfelt, 1984; Grant, 1991; Ahuja, 2000). One of the strengths of the resource dependence perspective is that it can explain uncertainty *management* (rather than simply uncertainty avoidance), in organisational behaviour. In the resource dependence view, firms seek to (a) reduce uncertainty within their operating environment and, related to this, (b) minimise their dependence on other firms, mainly because such a dependence on a specific partner firm would give that firm power over the focal actor (Spekman and Sawhney, 1992), or at least (c) to modify their resource dependencies on other firms (Provan, 1982). It is especially the *modification* of dependencies that is of interest in the airline alliance context. It appears that especially within multilateral alliances, autonomy and dependence are not mutually exclusive; one frequently encounters a situation where firms are simultaneously highly autonomous, and highly dependent on their partners (Dant and Gundlach, 1998), or in fact on the alliance itself.

The following discussion concentrates on the relation of individual airlines to their partners and, in the aggregate, to their alliance group. It can be argued that the airline alliance group constitutes an environment in its own right, an 'immediate' environment, or "task environment". This task environment buffers the individual airline from the outside

environment (and from direct competition with other airlines or federations), but it also requires the airline to negotiate its role, position, and power within it. A task environment that consists of a formally (albeit loosely) structured federation displays a certain degree of stability, or at least predictability, to the members of that federation. But because this federation is a structured form, and because it involves symbiotic interdependence, it also displays hierarchical elements. Thus, issues of domination and power asymmetries as well as tensions between individual and collective advantages (Jones et al, 1998) are present and must be negotiated. It is suggested here that the resource dependence approach offers concepts that are useful for understanding the mechanisms of inter- firm coordination within multilateral alliance groups, and that it can also help explain the stability –or lack of stability- of such groups. A further issue that RDP can help understand is that of firm specialisation. In brief, firms that operate in an unstable environment need to operate more as generalists, which is inherently inefficient, but will ensure that they can survive across a greater range of environmental states. On the other hand, if the operating environment is stable, a firm can afford to specialise: It will operate more efficiently, and do well, over a very small range of environmental states. Hannan and Freeman (1977) suggest that one way for firms to be able to afford specialisation even in inherently unstable environments is to form federations.

Airline resources

Since one primary aim of airline alliances is to seek geographical scope, the core resources of an airline within an alliancing environment consist what can be called its 'home market'. This refers to the route-system related, technical and nontangible resources in the set of markets where that particular airline has its highest operating density. Exploiting these resources can be seen as the airline's '*raison d'être*'. The 'home market' resource base is an aggregate of the two separate criteria used by Weber and Dinwoodie (2000), namely "Business Strength" and "Market Attractiveness" and can be classified according to the following criteria:

1. the *attractiveness* of that resource (e.g. in the airline case, access to a wealthy, high yield market and / or a central, uncongested hub)

2. the *uniqueness* of the resource (e.g. the degree of market dominance in the home market; "*substitutability*")
3. the *remoteness* of the resource (e.g. the difficulty of market entry from the outside. In the airline case, this refers to cultural remoteness, geographical remoteness, regulatory barriers and other factors which would render a potential competitor's establishment in those markets slow and costly; "*imitability*").

The concept of resource attractiveness is akin to what Pfeffer and Salancik (1978) call "Resource Importance", and the uniqueness of a resource is closely related to their notion of "Concentration of Resource Control". Resource uniqueness refers to the asset specificity of that resource, or how easily that resource can be obtained from another provider (Auster, 1994). Resource remoteness indicates the contestability of the market, e.g. how difficult or costly it is for an outsider to start operations in that market if there are "resource position barriers" (Wernerfelt, 1984). In the airline case, a carrier ideally obtains a powerful position in the network of airlines if it is *dominating* an *attractive* (i.e., wealthy, high yield) market which is *difficult to enter from the outside* (even in case of a completely deregulated environment, some locations are just geographically too remote to be economically 'exploited' by newcomers, or there are cultural barriers).

It appears that that in an alliancing environment, firms which have access to an attractive, imperfectly substitutable resource can afford to specialise to a greater degree because they have other partners specifically dependent on them for the provision of a coveted resource or resource bundle (in the airline case, this is most frequently domination of an attractive market). An example for such an airline reaping the benefits of specialisation within an alliancing environment is ANA of Japan. Their value to the STAR alliance consists in their contribution of the (highly attractive, and "remote" due to high entry barriers) Japanese market. The airline announced in 2002 that they would reduce their own intercontinental flights, increase codeshares with their partners Lufthansa and United on intercontinental routes instead, while concentrating more on serving domestic and East Asian routes.

On the other hand, airlines which do not control such an "exclusive" resource, but which are based at a central location and which operate more generalist services (for example,

most large Western European carriers such as British Airways, Lufthansa, KLM or Air France) tend to position themselves as 'link providers', connecting the specialists' markets between each others' and to their own route systems. An airline alliance group needs both types of airlines in order to offer adequate scope benefits to its customers.

The alliancing aptitude

Pfeffer and Salancik (1978) state that management is continuously engaged in "*negotiating a tradeoff between autonomy and survival*". Assuming that managerial efforts are indeed directed at ensuring their firm's autonomy, but recognising that some dependencies have to be entered into in order to ensure survival in a hostile and unstable environment, it is possible to say that a firm seeks to avoid or at least 'manage' dependencies through what can be called an *alliancing aptitude*. The alliancing aptitude of a firm comprises features which

1. give it negotiating clout within the alliance (once joined) to eliminate or cancel out asymmetries: "*The power of the participant* [in a coalition] *is a function of the dependence of others in the organisation on his contributions, activities, capabilities*" (Pfeffer and Salancik, 1978);
2. allows the firm to enter dependencies which are largely unspecific, and avoid specific dependencies on other firms;
3. and thus allow it to retain a certain 'Standalone Capability' in case the alliance fails, loosens or changes shape[3].

In the following sections, the term 'environment' will refer primarily to the airline alliance group itself (i.e., what will be termed 'network' or 'federated environment'). This appears justified in that the primary environment for an allied airline is indeed the alliance group, and resource configuration issues are relevant in relation to other network members, both at the formation and the implementation / management stages of the alliance. The resources of an airline can be classified into route- system related, technical, and nontangibles. Route- system related resources are traffic rights, slots at airports, and hub

[3] It is important to make this distinction: Most literature paints things in black and white, i.e., alliance failure or not. In reality, there are many 'shades of grey', each of which demand some response capability.

location and - characteristics. Technical resources refer to the airline's operating infrastructure and include its fleet, IT systems and know- how, and installations at hubs and outstations. Nontangible resources include the customer basis (e.g. Frequent Flyer top tier members; corporate accounts), the airline's overall reputation, and its brand.

Specific and unspecific dependence

Autonomy and dependence are not necessarily mutually exclusive in a partnership, because there might be dependence in some domains, and autonomy in others. The alliancing competence can thus be seen as the firm's capability to manage its dependencies within an alliance. In this context, it is useful to distinguish between two different types of dependence, namely specific, and unspecific dependence (Kleymann, 2002). A dependence can be said to be *specific* if it refers to a firm's dependence on one particular resource (and on the partner who controls that resource). That resource can then be said to be imperfectly substitutable (Morgan and Hunt, 1999) in the sense that a firm needs access to that resource, and to no other, to perform a certain vital function. There are two main problems related to entering specific dependencies. The first is that holding, or controlling access to, resources implies power (Pfeffer and Salancik, 1978). The power difference between two firms where one is specifically dependent on the other can possibly lead to an unstable situation in the case of a lack of goal consensus between partners (Borys and Jemison, 1989). A second problem related to specific dependencies is that the structural changes a firm makes to accommodate a cooperation with a partner on which it is specifically dependent represent sunk costs. Once these costs are incurred, the firm will seek to 'amortise' this investment, and is in a way held hostage to the cooperation.

A different situation occurs if the dependence is *unspecific*. In the case of unspecific dependence, a firm might still depend on partners for resources, or sheltering from competition, in the sense that it cannot survive on its own. But it is of less importance with which partner(s) the firm enters cooperation. In other words, the focal firm does not depend on any one particular partner; thus, partners (and the resources they control) are substitutable. The problems associated with a lack of goal consensus between partners still apply once a cooperation is entered; but in the case of unspecific resource

dependence, a firm always retains the option to choose among, and if necessary switch between, partners. The firm which is unspecifically dependent on cooperation with other firms is "*able to procure valuable resources from another party without losing control of one's own resources*" (Das and Teng, 2000a).

Specific dependence on an alliance

It is important at this point to consider that a firm can in fact be specifically dependent not only on a partner, but also on an alliance group. If one sees the alliance network as the firm's immediate 'task environment', it is this environment which needs to be stable and non- turbulent in order for a firm to reap the important membership benefit of a chance for what could be called 'carefree specialisation'. Carefree specialisation refers to a firm's ability to be able to specialise (i.e., concentrate on the provision and exploitation of core resources) while affording to curtail non- core ones, the maintenance of which had been hitherto needed in order to provide for the mastering of environmental uncertainties. The price to be paid for this is specific dependence on the alliance group. Hence, specialisation involves considerable risk and requires tight integration within the 'protective' alliance environment. There is, however, another type of risk inherent in tight integration into an alliance, namely "relational risk" (see e.g. Das and Teng 1999; 2000a; 2000b) , or opportunistic behaviour by partners. It has been proposed (Kleymann and Seristö, 2001) that there are, in addition to contractual stipulations which aim at limiting opportunistic behaviour by a partner, two interrelated mechanisms in place which can to some extent mitigate the risk involved at high levels of integration, namely *trust* and *alliance-specific investment,* or costs sunk into alliance membership. Alliance – specific investments provide stability in that they somewhat deter partners from opportunistic behaviour or defection. Generally speaking, in a relationship which involves specific dependencies and sunk costs, there is greater incentive to cooperate (or dissuasion to shirk) and thus a greater inherent stability in the federation. This can be illustrated by the following quote: *"We have now nine companies in Star and they have ten different reservation systems. Building one joint system is expensive and takes time. It could also make it impossible for an airline to leave an alliance"* (Lufthansa senior executive).

Managing dependencies: The concept of standalone capability

Members of an airline alliance group are required to relinquish some amount of authority to a joint governing entity, and they frequently carve up markets between themselves. This implies that an airline might have to cease being directly present in one market for the sake of a partner. If the alliance dissolves, the firms will be weakened at those points where they were formerly linked to partners. In an extreme case, the alliance members might operate to a large extent under a joint brand name, thereby sacrificing their own identity; in case of alliance dissolution, they will find themselves 'crippled', with the need to rebuild brands. If, say, a European airline that operates transcontinentally cedes a set of its routes to Asia to one of its Asian alliance partners and the alliance dissolves, that airline would need to incur the costs and efforts to re-establish itself on that market. This is one aspect of the opportunity cost related to tight integration into an alliance. Another example of opportunity cost related to alliancing is members being bound by exclusivity agreements: In tightly integrated airline alliance groups such as STAR, members are not very free to design their 'private' alliancing strategy beyond the airline alliance group itself, or to enter cooperative agreements with airlines outside the alliance group, even though such a cooperation might make sense for that particular member airline. Instead, alliance partners are bound to cooperate "exclusively" with partners from within their airline alliance group, with very strict limits set on the nature and extent of cooperation with outside airlines. This, in turn, has a set of effects on the airline's overall internal structure: In the event that the alliance fails, or if the airline leaves the airline alliance group, it may find it has developed structurally too much as an 'alliance member', and may have lost a certain 'standalone capability'. The concept of standalone capacity is in fact very important as one of the pillars of airline success in a federated universe. It is based on the assumption that the firm is compelled to undergo some changes upon federating with others, but that the internal restructuration of resource configurations to match the needs of the alliance or a partner is costly to a firm, and detrimental to its overall flexibility; in the words of Pfeffer and Salancik (1978): *"The price for inclusion in any collective structure is the loss of discretion and control over one's activities [...] Organizations seek to avoid dependencies and external control, and, at the same time, to shape their own contexts and retain their autonomy for independent action*".

In an operating environment where federation among organisations is a necessity (such as the airline industry), the concept of standalone capability does not necessarily imply a firm's ability to remain outside *any* federation; instead, it refers to the firm's continued capability to be a free, autonomous agent *within* its environment. In a network environment, this means *an agent capable of managing its interdependencies.* Standalone capability, thus, refers to the capability of a firm

- to survive for a certain (albeit limited) amount of time by itself in order to allow for the possibility of severing ties with existing partners,
- to have guarded enough key (or core) resources and capabilities under its own jurisdiction to make it an attractive partner sought for association with others, and
- to maintain sufficient operational flexibility and linkage resources to adjust parts of its structure to membership in a new alliance group.

Standalone capability guarantees that a firm maintains a role -and some power- within an alliance group by guarding its contribution to it, and that it is 'strong' enough to be able to afford looser coupling- or decoupling- from an existing partnership in order to seek a more optimal arrangement. Conserving standalone capability helps to de-specify the dependence of the firm on its partner(s) or the alliance group, in that it ensures the firm's ability to switch partners and buffers its core from shifts and changes within the alliance group. It is one of the features that a firm that aspires to maintain itself as a separate entity must most jealously seek to guard. Standalone capability rests on the protection of a firm's core resources and that firm's capability to interface these core resources with partners, without harming the core. In the airline case, core resources are likely to be route system related. Examples include the dominance of a hub airport, and a large share -if not dominance- of a certain market. Core resources are thus those resources that provide the 'unique contribution' of that firm to the alliance; they are the resources that partners seek to obtain from that firm through alliancing with it. The value of a core resource is a function of (a) internally to the firm: how many resources that resource can create (i.e., its value as a "*resource- creating resource*" (Håkansson and Snehota, 1995), and (b) externally: of how many firms are (specifically) dependent on it. These core resources will provide a basis for existence to an airline if and when a transition phase

between two alliances occurs, and they also help ensure that new partners can be easily found. On linking to a new airline alliance group, or integrating tighter into an existing group, airline management needs to be aware of this core, which should not be "bent" too much to the particular requirements of any one alliance group.

The 'alliancing competence' of an airline can thus be described as

a) the ability to maximally exploit core resources, and to successfully and flexibly build ties with other firms through linkage resources without harming, or endangering, the core
b) the ability to make partners specifically dependent on its own core resources, while striving to enter only unspecific dependencies by itself.
c) The ability to balance benefits from lean, specialist operations on the one hand and the need for retention of standalone capability on the other.

It was also suggested that while entering specific dependencies with one particular partner may be dangerous to a firm (unless it acquires equity and/or establishes a joint venture with that partner), the entering of specific dependencies with a federation, or alliance group, while still representing a risk, carries certain advantages in terms of provision of a stable operating environment without the need to seek equity investment in each or every partner. One crucial requirement for the minimisation of risk related to investing in specific dependence on an alliance is, however, that *all* partners involved in that federation must have entered similar specific dependencies: The federation can only provide stability (which is what is "bought" with alliance-specific investments) if all partners are tied to it and are equally deterred from instability- causing behaviour.

In the larger context of corporate governance, the discussion of interdependencies and standalone capability can be a basis for understanding managerial action, since the ability of decisionmakers to make a 'choice' depends frequently on how far they could preserve autonomy in the environment (Child, 1997). A good complement to this structural view is thus research on the managerial side, to investigate whether there exists some 'countervailing power' to alliance integration in the managerial quest for independence (Galbraith, 1967; Dant and Gundlach, 1998) and to depict the features of an "alliance mindset" (Spekman et al, 1998) of key actors as a function of the balancing of standalone requirements with dependence on an alliance. This issue will be addressed next.

Part Two: Multilateral alliance building from an institutionalist perspective

This section approaches the behavioural side of multilateral alliancing by taking an institutionalist perspective. Alliances between airlines are agreements of tight cooperation between autonomous, but increasingly interdependent, organisational actors. They do not only strategically concern certain parts of the firms' overall operation (as would be the case in a JV), but rather often the entire firm. Hence, they require a considerable amount of inter-organisational coordination. This coordination, in turn, is made more complex by the fact that it needs to take place at a multilateral level and that neither a clear hierarchy nor a 'blueprint' for coordination efforts exists. One can say that alliancing is being 'invented' by airline managers as they continuously coordinate – and try to reduce the need to adapt- their resource allocation and decisionmaking. Alexander (1998) describes inter-organisational coordination as "*a form of social structure: a set of rules and norms that enables and constrains action, and which is itself continually re-enacted.*" This section investigates to what degree and in what form coordination between airlines acquires such a social structure (Barley and Tolbert, 1997; Hendry, 2000). In more detail, the question is how the managers of an airline are building and enacting the concept of 'allianc*ing*'. This section aims to shed some light on the processes behind the establishment of 'alliancing' as an institution, and on the question of what kind of institution 'alliancing' is eventually going to become.

On a fairly general level, Scott (1995) defines institutions this way:

"*Institutions consist of cognitive, normative, and regulative structures and activities that provide stability and meaning to social behaviour. Institutions are transported by various carriers - cultures, structures, and routines- and they operate at multiple levels of jurisdiction*". In the words of Goodrick and Salancik (1996), institutions can be seen as "*social facts*", existing as the "*context within which interests operate*". Cultural elements and cognitive structures that have reached institutional status are assumed to have a profound impact on organisational behaviour. Other terms used to describe institutions are "mental template" or "the totem around which the tribe is dancing". In what is considered to be one of the seminal articles on the institutionalist perspective, Meyer and Rowan (1977) explain the way institutions influence organisational practices like this:

"*Organisations are driven to incorporate the practices and procedures defined by prevailing rationalized concepts of organisational work and institutionalized in society. Organisations that do so increase their legitimacy and their survival prospects, independent of the immediate efficacy of the acquired practices and procedures.*" A part of 'rational' action might thus well be directed toward, for example, the acquisition or maintenance of legitimacy. The main argument for institutional theory's usefulness as one basis for the examination of the phenomenon under study is the conceptual flexibility and explanatory power of this theoretical approach. The institutional perspective accommodates external 'realities' -whether or not they are manipulated by actors- as well as actor's attempts at rationality, and several degrees of bounded, or 'local' rationalities, such as allegiance to institutions, hypocrisy, myths and re-action on (distorted) perceptions. Highlighting the value of institutional theory as a complementary approach to more "technical" perspectives such as RDP, Bartunek (1984) states that "*Environmental forces are likely to initiate the change, but the way the environment is perceived by organisational members affects the type of change that takes place*". In other words, firms are "living" in an environment that they themselves have created, and the way they create it is very much a function of their interpretations and shared understandings.

Grasping these shared understandings was the target of the round of interviews performed with airline managers. Following a Grounded Theory approach to data evaluation (see, for example, Glaser and Strauss, 1967; Martin and Turner, 1986; Strauss and Corbin, 1998; Locke, 2001), in a first round of data sighting the material obtained was checked as to whether there were any common themes or 'issues' that were brought up with a certain frequency. Concentrating on these "in vivo labels" (Strauss and Corbin, 1998), or the main issues addressed in manager's discourse, was based on the idea that selectivity is an essential characteristic of consciousness (Scott, 1995), i.e., the 'perceived truth' (or what one could call 'para-truth') is very much a function of selected and re-produced discourses. Aided by previous participant observation and general knowledge of the specific industrial context of the airline industry, it was then sought to conceptualise these issues. From the discourses on alliancing that emerged out of the empirical material collected, three main thematic groups (reflecting 'issues') could be identified, namely

'Positive', 'Pragmatic', and 'Independence'-related discourse. Within each of these groups, discourses could be classified into a number of sub-themes.

Alliancing discourses in the airline industry

The issues that emerged from the empiria could be grouped into whether they were 'positive', 'pragmatic', or 'reluctant'.

'Positive' discourse mentioned the benefits of alliancing. This occurred almost exclusively in media directed toward a stakeholding public (e.g. passengers or investors).

'Pragmatic' discourse implied that alliancing as such did no longer require any justification. Alliance membership was accepted as a "fact of life", a necessary defensive move, and it was frequently stressed that the airline had no real choice but to engage in alliancing. Frequently, interviewees did not stay much on the discussion of whether or not alliance membership was a god thing, and moved on to discuss the day-to-day problems of alliancebuilding, such as lengthy meetings, difficulties to reach consensus, etc. Several middle managers (but interestingly, no senior managers) called for more authority of the alliance governance structure to resolve these inefficiencies.

The third big block was 'reluctant' discourse: Here, the emphasis was on keeping the influence of alliance membership at arm's length. The theme of the airline as having a special culture, and/ or as a national symbol was often mentioned as a justification for keeping as much independence as possible, and it seems that especially stakeholders and lower- level employees were rallied around this theme. Further, especially senior management frequently expressed concerns about their airline losing its independence to the alliance, and some even admitted that they "avoided" alliance group membership by operating portfolios of bilateral agreements with various carriers instead.

The following table depicts the distribution of discourses that occurred in the empiria collected:

Issue		PR	Media	Senior Mgmt	Mid Mgmt	Front-line
POSITIVE	**good for customers & shareholders**	**HEAVY**	yes			some
	good for airline	**HEAVY**	some			
PRAGMATIC	**defensive**	some	yes	yes	yes	some
	no choice	yes		**HEAVY**	**HEAVY**	**HEAVY**
	implementation problems		some	yes	**HEAVY**	yes
	call for more alliance authority	yes			**HEAVY**	
RELUCTANT	**airline culture**	some			yes	**HEAVY**
	nationalistic	**HEAVY**	yes		some	**HEAVY**
	buffering			**HEAVY**		
	avoidance			**HEAVY**		

Table 1: Themes in alliancing

'Countervailing Myths' in action

If one takes spoken and written discourse as reflecting processes of institutionalisation, (as e.g. in Johnson et al, 2000; Walgenbach, 2001; Wicks, 2001), it seems that some of the strategic responses to institutional processes[4] that were described by Oliver (1991a) occur *simultaneously* in a firm, at least at discursive level and during times of organisational and institutional change. In the present case, of these four strategies especially acquiescence (obeying rules and accepting norms) and avoidance ("buffering"; loosening institutional attachments) seem to be competing reaction schemes. This can be called the phenomenon of 'countervailing myths'. On one hand, actors gain legitimacy by referring to the 'positive' myth of alliancing being good for the shareholders, and of alliancing as improving the competitive advantage of their firm. On the other hand, the very same actors gain legitimacy in front of another (e.g. internal) constituency by

[4] The four responses are: Acquiesce, Compromise, Avoid, Defy, Manipulate (Oliver, 1991a)

referring to the myth of 'independence' with which the airline buffers itself from the alliance. In short, countervailing myths exist because of loose coupling; actors need to be seen serving (or gaining legitimacy in front of) different constituencies with sometimes opposing agendas. The "Partisan" and "Independence" themes can be seen as countervailing forces to the establishment of alliance membership and of the alliance itself as a strong institution[5]. This is in line with Bartunek (1984), who found that changes of interpretative schemes occur in a "dialectic" manner in that there is interaction between old and new ways of interpreting. Johnson et al (2001) call this "competing institutional templates". The dialectic concept is indeed useful because it assumes a process, rather than a static perspective on institutions[6]. In addition, examining the dialectic aspect of organisational processes is helpful in investigating an organisational phenomenon where two somewhat antagonistic social structures (in this case, the individual airline and the alliance group) both claim allegiance.

In concrete terms, the airline managers' allegiance is still very much with their own firm. While the need to form alliances is recognised, and no longer questioned as such, the "own airline" is a very strong institution, and there is a tendency to buffer one's firm from overly great influence of the alliance itself, or any partner. While to the outside world, alliance membership is praised and has a certain legitimacy- giving function (especially if membership to an alliance group can be considered a "seal of quality" for an airline), internally, the onus is still very much on preserving one's firm autonomy as far as possible. It is to their own, independent airline that managers' allegiance is directed. An uncertain alliancing environment is unlikely to change this, but it is precisely this unwillingness to think in "alliance terms" that creates the instability of the groups.

Part Three: Combining the two perspectives- the dynamics of multilateral alliancing

This final part will combine the two previously sketched perspectives on alliancing and describe a framework of the dynamics of multilateral alliancing. This framework takes

[5] i.e., an institution that is an integral part of actor's mindsets, in contrast to a 'weak institution, which would only require lip service, or legitimacy- enhancing behaviour. For a classification of institutions, see Kleymann (2002).

[6] This concept also implies that institutionalisation is not seen as a dichotomous variable but rather that there are different institutions which represent continua (degrees of institutionalisation) and which co- exist and compete for the allegiance of an actor.

into account the interaction between behavioural and resource interdependence- related factors which determine the evolution of multilateral alliances.

The study described in this paper has examined the emerging phenomenon of multilateral alliances from two complementary angles, namely the resource dependence perspective, and institutional theory. By taking into account both resource interdependencies and individual 'sensemaking' and 'sensegiving' as reflected by the discourse of airline executives involved in alliancing, it was possible to identify an apparently contradictory requirement for alliancing from the firm's point of view: The airline must ally (due to resource interdependencies), but due to the continued instability of the task environment, it must also seek to preserve its standalone capability. It must specialise and exploit its own niche as much as possible to increase efficiency and to make other firms specifically dependent on it. At the same time, it must strive to avoid any specific dependencies itself. In brief, the task environment of the alliance can still be considered to be relatively unstable, mainly due to the following dimensions of uncertainty in multilateral alliance coordination:

- "Multilateralism": Cooperation between two partners may influence relations with a third, or the group as a whole.
- Indeterminacy: The organisation invents itself, on the basis of the local rationalities of actors who owe allegiance to their firm, but not to any superstructure.
- Strong perceived ambiguity: This is related to the previous point. There is no blueprint of what the alliance group should look like.
- Resource interdependencies are more difficult to manage due to strong partner heterogeneity – there are significant power asymmetries and a large diversity as to resources and policy goals: Some want to dominate the alliance, others seek membership as a shelter.

The dimensions of uncertainty listed above can be assumed to influence the degree of integration into an alliance (a superstructure) of individual airlines and thus in the aggregate, the stability of the alliancing task environment. The following figure to schematically depict the dynamics of multilateral alliancing:

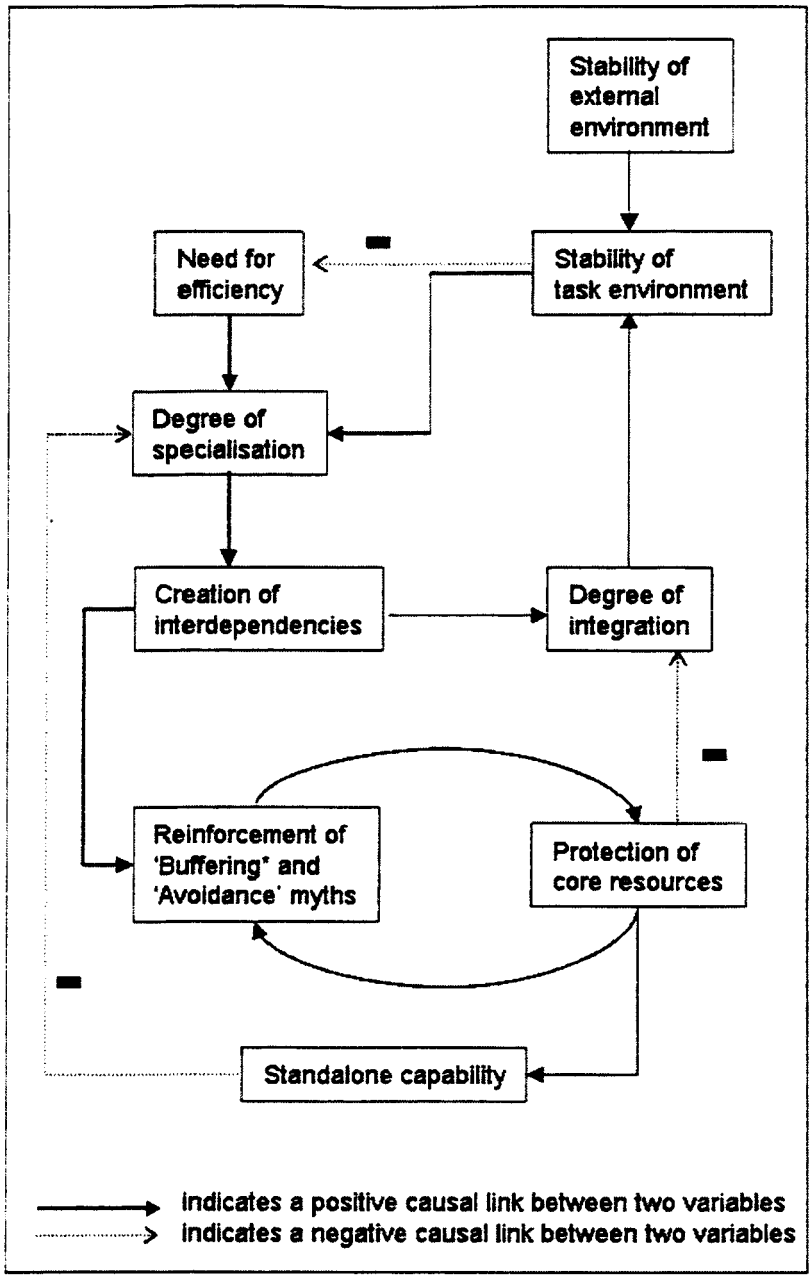
Stability of external environment
Need for efficiency
Stability of task environment
Degree of specialisation
Creation of interdependencies
Degree of integration
Reinforcement of 'Buffering' and 'Avoidance' myths
Protection of core resources
Standalone capability
indicates a positive causal link between two variables
indicates a negative causal link between two variables

Figure 1: The dynamics of multilateral alliancing as a function of resource interdependencies and institution - building

The primary assumption is that the stability of the firm's task environment (i.e. the alliance group, or at least allianc*ing* in case of an airline opting for a portfolio of bilaterals approach) is influenced by both exogenous and endogenous factors. Exogenous factors stem from the wider environment and include the industry regulation, economic cycles, prices for fuel and aircraft, etc. The endogenous factors refer to those which are

residing within the task environment itself, both at firm (for example, the degree of a firm's specialisation) and alliance group (for example, interdependencies between firms) levels. In an uncertain and unstable task environment, firms are pushed toward a generalist position, in order to be fit across a wider range of environmental variations (in other words, the environmental stability is positively related to the degree of specialisation). On the other hand, the instability of the environment paired with industry characteristics (very capital intensive and at the same time very low margin) establishes an imperative on firms to be highly efficient (environmental stability is negatively linked to the need for efficiency). This, in turn, favours specialisation.

Thus, the **first ambiguity of airline alliances** is that the instability of the environment both favours and obstructs specialisation. Specialisation is, however, to some extent unavoidable -it can be said that in an industry where scope benefits are a significant determinant of competitiveness, every firm is to some extent a specialist. As proposed by Hannan and Freeman (1977), specialist organisations in an unstable environment tend to federate with each other. This specialisation in a network of actors can be said to increase interdependencies between them. Provided- and this is one of the basic assumptions of the study- that the firm's primary aim is survival and the preservation of its identity, one major reaction at individual actor level to the perception of interdependencies is a reinforcement of myths relating to 'independence' and 'avoidance' of these dependencies. This is because allegiance to one's own firm is a strong, and high-code institution. The reaction at firm level is to protect the firm's core resources. This protection of core resources is tightly related to the establishment of a standalone capability, which in turn somewhat reduces the possible degree of specialisation. At the same time, the protection of core resources also reinforces (and is reinforced by) the individual actor's allegiance to the airline's self- identity. In other words, they tend to think more in favour of their own firm, rather than the alliance. And this, in return, sanctions core-resource protecting behaviour even more. This loop can be considered a case of fortress building where institutional forces and resource protection efforts jointly act to protect the firm from dependencies. Fortress building in itself is caused by interdependencies; but it is countervailing to them because it aims at reducing the degree

of integration between organisations. The degree of integration between partners, in turn, can be expected to significantly influence the stability of the task environment.

The above model depicts the interaction and recurrence of processes that shape the phenomenon of multilateral alliancing. It illustrates the power play between the two main forces which determine alliancing: 'Fortress building' and 'Environmental Instability' and it allows for- and combines- both the behavioural and structural aspects of the alliancing process. What this rather schematic model does not depict is the distinction between specific and unspecific dependencies, in other words, what facilitates or precludes the retention of standalone capability of a firm, and possibly constitutes a source of power over other firms. Interdependencies can create risk or reduce risk in a focal airline's immediate task environment. As explained in part one, they create risk in case of specific dependencies from one airline's side on a partner or on an alliance. They can reduce risk if every other partner also has a specific dependency on that alliance. This, however, requires the existence of a superstructure at federation level, to which all partners agreed to submit, and to which they are all equally bound. The dilemma here is that in the present case of alliancing in the airline industry, the *building* of the superstructure has still not attained the level of a strong (and enforced, or at least legitimately sponsored) institutionalised norm. This then constitutes the **second ambiguity of alliancing**: Partners will all benefit from a stable and predictable task environment, but each of them is reluctant to contribute to the building of such an environment. The root of the problem seems to be that local rationales (and -allegiances) still override any meta- rationale, and there is no hierarchically superior 'authority' in place to impose these meta- rationales, nor is there any "issue sponsor" (Dutton, 1993) who could legitimately create such an 'authority'.

It is primarily due to airline managers' "local allegiances" that at least the medium- term future, alliance groups between airlines can indeed be considered to be constantly re-negotiated environments, and, therefore, somewhat unstable. This means that few, if any, airlines will be able to reap the full benefits from specialisation within a group, because they will still need to retain some standalone capability in order to ensure survival in case the alliance group they belong to collapses, or changes shape. The implication for airline management is twofold: First, excessive reliance on the future of one's alliance group

could prove dangerous, but wise management of interdependencies with partners can provide a carrier with a reasonably stable operating environment for at least the shorter term. A cautiously positive approach to alliance group membership appears to be appropriate. Second, a stable operating environment means, to some larger carriers at least, influence over smaller competitors through alliancing. This has, for example, clearly been Lufthansa's strategy over the past years -tying SAS, Austrian Airlines, Eurowings and LOT into tight cooperation. To a smaller airline, alliance membership could then well "clip their wings", reducing them to feeder status (a fear that was openly expressed by a senior SAS executive), and in an extreme case jeopardising their standalone capability. This "gravity pull" of larger carriers will persist, and be a continuing influence in alliancebuilding. Smaller carriers must seek to avoid specific dependencies, and "protect" their core resources so as to retain standalone capability. One way to achieve this might be by joining an alliance group that is less tightly integrated, even though this might mean a less stable immediate operating environment. For these airlines, stabilisation could well be achieved by cooperating with "peers", partners of equal size, that cover a complementary geographical network.

The scheme of alliancing dynamics described in this paper does not allow any concrete prediction of where alliancing will go. But an understanding of the factors which cause the dynamics (or instability) of multilateral alliances might well help the individual firm to position itself adequately for such an environment. What can be suggested from the study that was briefly described in the present paper, is that an individual airline's well-being in a "federated environment" will depend on (a) its resource configuration (i.e. especially route network and hubs), and, related to this, (b) its ability to negotiate interdependencies with other carriers. Cognitive processes and managerial sensemaking and sense- giving have been found to be of as much importance to the shaping of alliancing as resource constraints, and future studies could study the dynamics of alliance groups as self- organising structures further, by adding a complex systems perspective.

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New insights into the single-till versus dual-till airport pricing debate

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Abstract

Some countries have recently reviewed how they regulate the pricing of aeronautical services (landing charges, aircraft parking charges, terminal facility charges etc.) at their principal airports. One major issue that has emerged from each of these reviews is whether it is preferable to adopt a single-till or dual-till approach to pricing aeronautical services. In this paper the arguments for or against each approach are discussed within the context of reasonableness, implementation, the effects on economic efficiency and the influence of other policy considerations. The paper also finds that the criteria by regulators used to decide between different approaches have often been influenced by a range of non-economic factors. The paper suggests a number of alternative approaches to adopting pure dual-till and single-till models such as, asset re-valuation, redefining the scope of regulated activities, applying the dual-till to new investments only, adjusting the allocation of common costs between tills and allowing airport users to secure a financial stake in the airport. Furthermore, it is also recommended that in order to reduce uncertainty, the regulatory approach should be specified in the relevant legislation.

Keywords: airport pricing approach; single-till; dual-till; economic regulation

1. Introduction

Airport services consist of the provision of facilities for aircraft landing, taxiing and parking and for processing passengers as well as retailing, car parking and other commercial functions. These services are broadly categorised into aeronautical and non-aeronautical (or commercial) (Doganis and Nuutinen, 1983, p. 77). The revenues from aeronautical services (i.e. aeronautical charges) mainly encompass aircraft landing, parking and passenger charges, while revenues from all other sources are classed as non-aeronautical. Australia, Ireland, New Zealand and the United Kingdom recently reviewed their approaches to regulating aeronautical charges. The respective regulatory authorities in these countries have had to address the issue of whether it is preferable to adopt a single-till or dual-till approach to determining the maximum level of aeronautical charges. The main difference between the two approaches is whether or not they incorporate non-aeronautical profits in calculating the required level of aeronautical charges. If non-aeronautical profits are taken into account and used to subsidise aeronautical services, aeronautical charges can be set lower than that receiving no subsidisation from non-aeronautical operation.

For those airports without congestion problems (i.e. demand exceeding supply), adopting a single-till pricing, which allows for non-aeronautical revenues to subsidise lower aeronautical charges, seems intuitively reasonable. Over the past two decades, however, a growing number of airports have become congested. The arguments for maintaining the single-till approach become less clear as demand is being artificially stimulated over the capacity the airport can accommodate. In order to achieve an efficient allocation of scarce resources, aeronautical charges should progress toward the market-clearing level to establish equilibrium in the demand and supply of slots. There is also a problem of establishing a pricing system that incentivises the airport to expand aeronautical capacity (runway, passenger terminal) when demand approaches or exceeds supply. The single-till principle, which

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incurs financial losses on the provision of aeronautical services, cannot provide the necessary incentive to increase capital expenditure. With the spread of corporatisation and privatisation and the ensuring effects on management strategic priorities and goals, airport operators are increasingly demanding the adoption of the dual-till approach, which would allow for aeronautical charges to recover the costs of providing aeronautical services. Dual-till pricing would also allow the airport operator to retain the profits generated from non-aeronautical services, rather than using them to subsidise lower aeronautical charges. Airlines, on the other hand, are concerned about the implications of moving toward dual-till pricing and argue that since they carry passengers who potentially contribute to the airport's non-aeronautical revenue, they should benefit from this by enjoying lower aeronautical charges

The single-till and dual-till approaches are usually manifested in a price-cap form of economic regulation. This model exists in, for example, Austria, Germany, Ireland and the United Kingdom. As more efforts have been put on consulting the airport operator and users while reviewing price caps and regulatory regimes, disputes on the choosing between the two approaches have become acute (ACCC, 2001a; ACCC, 2001b; CAA, 2002a; CCUK, 2002). This paper aims to explore these disputes and provide some insights into the selection of regulatory approach. In the following sections, economic characteristics of the two pricing approaches are introduced in Section 2. Debates on the single till versus the dual till are discussed in Section 3. The determining criteria considered by regulators are inferred in Section 4. Recognising that there are deficiencies in both approaches, Section 5 considers five alternatives. Section 6 depicts future prospect, and concluding remarks are finally given in Section 7.

2. Economic characteristics of the single-till and dual-till approaches

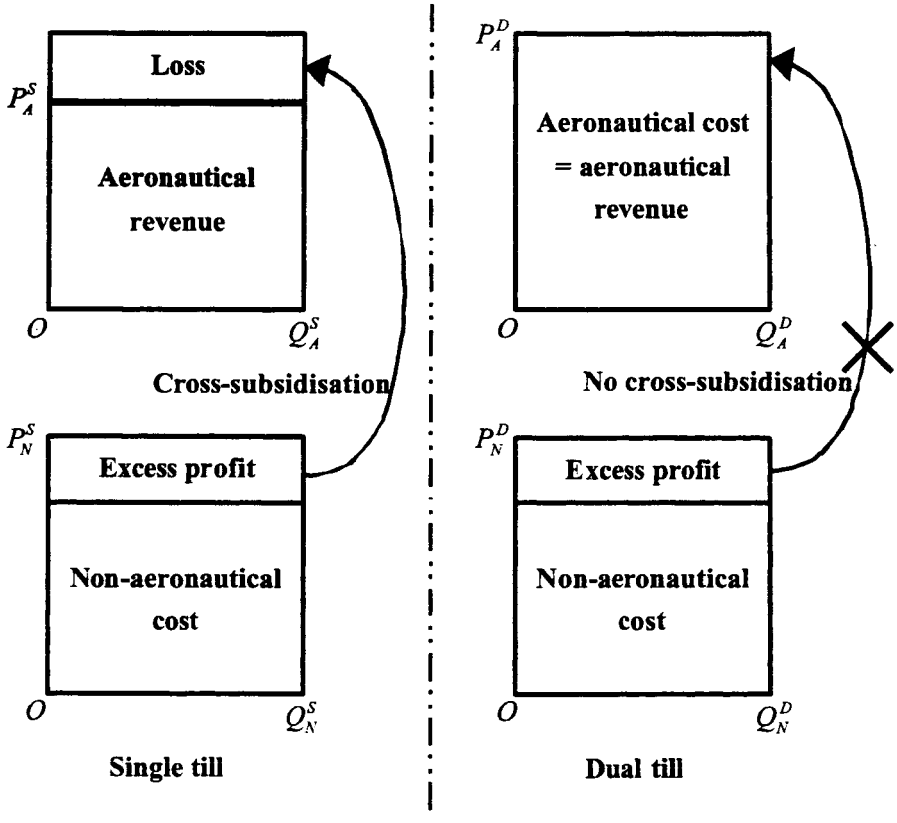
An important feature of the airport's operation is the demand complementarity between aeronautical and non-aeronautical services. Demand for non-aeronautical services (thereinafter non-aeronautical demand) mainly comes from passengers carried by airlines that generate demand for aeronautical services (thereinafter aeronautical demand). An increase in the quantity consumed for aeronautical services will raise the level of non-aeronautical demand (Starkie, 2001). In other words, the quantity of aeronautical services consumed would largely determine the level of non-aeronautical demand. In pursuing non-aeronautical profits, airports have incentives to adopt such a pricing policy that creates and attracts the most airlines using the airport and bringing the most passengers to purchase non-aeronautical goods or services. [1] If any decreases in aeronautical revenue incurred from lower aeronautical charges can be outweighed by increases in non-aeronautical profits, airports will have an incentive to adopt a pricing approach that can attract additional traffic and subsequently improve their overall returns by substituting aeronautical revenue for non-aeronautical revenue. Demand complementarity between aeronautical and non-aeronautical activities indeed has a considerable impact on both the airport's pricing and capacity expansion decisions.

Historically, aeronautical revenue was the primary source of the airport's income. However, over the past decade, non-aeronautical revenue has grown dramatically both in proportion and in magnitude. This is partly because airports (particularly those privatised or corporatised) have incentives to earn more from non-aeronautical services that are formally outside the scope of economic regulation.

[1] The largest number of airlines using the airport dose not represent that these airlines will bring the most passengers to the airport, and nor the most passengers using the airport can guarantee that these passengers will spend the most on non-aeronautical services and incur the most non-aeronautical profits to the airport. Actually, there are two factors influencing the level of non-aeronautical profits: (i) the average number of passengers per aircraft movement, which will decide the total passenger throughput of the airport, and (ii) the number of high-spending passengers, which will finally be reflected in their consumption of, and the airport's revenue from, non-aeronautical services.

Behnke (2000, p. 14) points out that the proportion of non-aeronautical revenue to total revenue for more than 1,400 airports had grown from about 30% in the late 1980s to over 50% in 1998. This implies that increased non-aeronautical revenues and profits could enable airports to reduce aeronautical charges and further attract more traffic. Those airlines that are price sensitive to aeronautical charges (e.g. low-cost carriers) may thus be encouraged to use aeronautical services more.

Demand complementarity and the growing significance of non-aeronautical business have given the background of the single-till approach. Generally speaking, the single till takes not only aeronautical but also non-aeronautical revenues and costs into consideration to determine aeronautical charges. The corresponding regulatory asset base (RAB) comprises all airport assets, regardless of their functions or characteristics. There will be cross-subsidisation of non-aeronautical profits to offset the deficits of aeronautical services in which lower caps on aeronautical charges are resulted due to the expectation by regulators of non-aeronautical profits. Incentives for the airport to optimise non-aeronautical profits are hence lessened. Conversely, the dual-till approach separates aeronautical functions from non-aeronautical ones. It determines the level of aeronautical charges by considering aeronautical revenue and cost only, and therefore the corresponding RAB includes aeronautical assets only. There will not be any cross-subsidisation of non-aeronautical profits to offset aeronautical costs. In other words, aeronautical charges set by the dual till are probably higher than that determined by the single till. Economic rents will be transferred from airlines to the airport if switching from a single till to a dual till, and the airport will enjoy higher overall returns. Fig. 1 depicts the major difference between the two approaches.



P_A^S, P_A^D = Aeronautical prices under the single till and dual till respectively;

Q_A^S, Q_A^D = Aeronautical quantities under the single till and dual till respectively;

P_N^S, P_N^D = Non-aeronautical prices under the single till and dual till respectively; and

Q_N^S, Q_N^D = Non-aeronautical quantities under the single till and dual till respectively.

Fig. 1 Primary differences between the single-till and dual-till approaches

Pricing approaches play a crucial part in relation to dynamic efficiency, such as providing signals for capacity expansion. However, cross-subsidisation between two sets of services, as occurred when adopting a single-till approach, could blur investment signals for and confuse decision-making on developing each set of services. Also, recent studies (Starkie, 1999; Starkie and Yarrow, 2000; Starkie 2001; Reynolds-Feighan and Feighan, 1997; CAA, 2000; PC, 2002) suggest that the single till has resulted in allocative inefficiencies for capacity constrained airports, because increased non-aeronautical revenue keep aeronautical charges at a low level[2] and hence excess demand is artificially stimulated. Under current situations where the commonly used 'grandfather' rule and the bilateral negotiation might not satisfy the requirement of optimising usage of scarce resources, aeronautical charges are thus advocated being set at such levels that enable scarce capacity to be efficiently allocated and used. These arguments contribute to the suggestions for reforming the regulatory approach.

3. Debate on the single-till versus dual-till approach

Recently the UK Civil Aviation Authority (CAA) decided new caps on aeronautical charges for four largest airports for the next five years from April 2003. In New Zealand, the Commerce Commission (CCNZ, 2002) has recommended price controls to be applied at Auckland Airport. The Australian government has, since July 2002, removed direct price regulation from major airports, replacing it by indirect price monitoring for five years. The issue of opting for a single-till or dual-till approach has been intensely discussed in the above reviews. Airports generally favour the dual-till regime, while airlines argue for the single-till principle. The advantages and disadvantages of each approach have been raised in ACCC (2001b), CAA (2000), CCUK (2002), CfAR (2001), NECG (2000), Starkie (1999; 2001), Starkie and Yarrow (2000), and Lu and Pagliari (2003). These arguments are classified into four categories as follows.

3.1 Justice and reasonableness arguments

The single-till approach is generally defended on the basis of demand complementarity. In the non-aeronautical context, for example, airlines lease offices from the airport while passengers purchase products from retail outlets. One group of users of non-aeronautical services may contribute more to non-aeronautical revenue than another. According to Graham (2001), leisure travellers on long-haul international services spend more on non-aeronautical services than business travellers on short-haul journeys. There is, therefore, a persuasive argument for extending the benefits of lower aeronautical charges (under the single till) to those airlines that carried passengers who contributed most to non-aeronautical revenue. In other words, if the airport earns more non-aeronautical profits from long-haul passengers, then a larger proportion of these profits should be used to lower aeronautical charges for long-haul flights, rather than current situations where every flight enjoys similar benefits of lower charges. This proposition would encourage long-haul (international) flights or larger aircraft that

[2] For example, if aeronautical assets (runway(s), aprons, piers and aerobridges) at London BAA Airports were to earn an 8.6% real rate of return in 2000/01, the level of aeronautical charges would require rising by almost 20% (CCUK, 2002, para. 2.62).

usually carry more passengers who may spend more on non-aeronautical goods or services, while short-haul (domestic) flights and smaller aircraft would be discouraged. The utilisation of capacity may be improved subsequently, but contradictions to national regulations and international conventions may also arise. For example, ICAO (2001) has advised airports adopting the principles of cost-relatedness, transparency and non-discrimination in setting aeronautical charges. Such a pricing method that directly links contributions to non-aeronautical revenue with the payment of aeronautical charges would probably breach cost-related and non-discriminatory principles.

The conventional argument, often asserted by airlines, is that airlines should be entitled to lower aeronautical charges because they carry passengers who contribute to non-aeronautical sales. According to PC (2002), this assertion can be challenged on the basis that successful exploitation of non-aeronautical activities is not entirely due to the contribution of passengers, but more importantly, is mainly as a result of the airport's efforts in planning and developing non-aeronautical business. Neither airlines nor passengers have shared in any risks of or the responsibilities for operating non-aeronautical services, and therefore should not have any intrinsic rights over non-aeronautical profits (CAA, 2001, p. XVII). Instead, other entities, including concessionaires who develop and promote the creation of such profits, have more rights to share in non-aeronautical profits through perhaps accommodating rentals or concession fees.

If demand complementarity is the reason argued for the single till, whether or not the airport should share these profits with airlines will be addressed adequately by the market itself (PC, 2002, p. 376). In addition, airports have incentives to encourage additional traffic and passengers (either by lowering prices or through another means) in order to increases their non-aeronautical (and overall) profits to the extent such complementarities exist. They are at superior positions to decide whether or not to cross-subsidise and who should be the beneficiaries of such cross-subsidisation. It may, therefore, not appear necessary to regulate the airport by the single-till principle to ensure that airports engage in such behaviour.

3.2 Implementation arguments

The implementation of either approach involves a number challenges for the regulator. These include the difficulties, the additional costs and the risks of regulatory failure in applying either approach. These implementing issues are closely related to the regulatory scope. The regulatory scope of the dual till is intuitively smaller than that of the single till, but the burden of implementing the dual till would not necessarily lessen due to the problem inherent in allocating common costs between aeronautical (regulated) and non-aeronautical (unregulated) services (CAA, 2000; CCUK, 2002; NECG, 2000). For example, air conditioning and seating areas within the terminal are often used for both aeronautical and non-aeronautical purposes. In separating this sort of common costs, a degree of arbitrary judgement would be inevitable. The single till, similarly, is associated with a level of administrative burden that the regulator is required to have knowledge and possess forecasts on the non-aeronautical business.

The risk of regulatory failure is as a consequence of the level of information asymmetry existing between the airport and the regulator. Since the regulator is dependant on the airport operator for information, it is difficult to extract all the required information, particularly in the area of non-aeronautical activities. The likelihood of the regulatory failure is greater under a single till than under a dual till, because more detailed information about non-aeronautical operation is required under a single till. To a lesser extent, allocating common costs (or revenues) also requires information on the non-aeronautical business. Therefore, the dual till also involves risks of regulatory errors.

There is no pragmatic studies on analysing the monetary costs that the regulator, the airport operator and airport users need to spend on investigating, providing information, forecasting, preparing documents etc. In the long term, no significant difference in the implementing costs between the two approaches will be resulted, because the tool and experience of forecasting non-aeronautical business will become mature and the guidelines of allocating common costs will be established. The implementation arguments might have influence on selecting the regulatory approach in the short term but would not be the main consideration from a long-term perspective.

3.3 Economic efficiency effect arguments

The major difference in the outcome between both approaches is that the level of aeronautical charges will be varied. Roughly speaking, a switch from a single till to a dual till would result in a $(q/p - 1)\times 100\%$ increase in aeronautical charges, where p is the ratio of aeronautical revenue to total revenue and q is the proportion of aeronautical cost to total cost of the airport under a single till (see Appendix for derivations). The larger the value of q/p (or the larger difference between q and p), the higher the aeronautical charges under a dual till (than under a single till) and the larger the impact on economic efficiency effects. If the level of aeronautical charges decided by a dual till does not depart substantially from that set by a single till, there will be little intellectual mileage in debating which approach is superior. As non-aeronautical revenue grows substantially, q/p will become larger. The required increases in aeronautical charges under a dual till as opposed to a single till therefore become considerable.

There are difficulties associated with deriving practical estimates of the implications of adopting each approach on allocative, dynamic and productive efficiencies. There are several reasons for this. First, price-cap regulation in which both approaches are built, cannot simultaneously achieve all forms of efficiencies because there are often trade-offs between these efficiencies. Second, both approaches determine price caps on aeronautical charges with reference to the airport's cost plus a target rate of return. This is akin to cost-based regulation. Adopting either approach may lead to cost-padding or Averch-Johnson effects (PC, 2002, p. 282).[3] Thirdly, in specifying an optimal plan for investment, in estimating demand elasticities associated with the use of aeronautical services and in determining an efficient level of airport costs, there is a requirement for a sufficient level of quantitative information, but it is difficult to acquire in practice. Lu and Pagliari (2003) argue that the dual-till approach causes less distortion than the single-till approach in dynamic efficiency, because the dual till can bring more perceived benefits to airports and therefore incentivise those airports with severe excess demand to invest new capacity earlier. Their model shows that the dual till is preferable in respect of allocative efficiency where demand is approaching or over capacity, while the single till is desirable where excess capacity exists. CAA (2000, para. 3.40) has similar arguments but emphasise various empirical questions that need to be resolved to reach a firm conclusion. The effect of both approaches on economic efficiency is also dependent on other factors, such as planning permission for capacity expansion and environmental or space constraints. It is, therefore, difficult to precisely evaluate the magnitude of each approach's impact on economic efficiency.

In theory, a dual-till approach potentially generates better economic efficiency outcomes for congested airports, while a single till performs better at uncongested airports. In practice, however, due to the inability to derive a quantitative approximation of economic efficiency, debate on the effect of the single till versus the dual till on economic efficiency is unlikely to reach a definitive conclusion.

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[3] The single till that use non-aeronautical profit to lower aeronautical charges could weaken the airport's incentive to minimise non-aeronautical cost, as opposed to the dual till that the benefits of saving non-aeronautical cost could be retained by the airport itself.

3.4 Policy considerations arguments

The decision on which pricing regime to adopt can also be influenced by broader political factors. First, the regulator may consider encouraging additional traffic and stimulating local and national economy by keeping aeronautical charges at lower levels. A single till thus becomes its preference. Besides, setting charges at a low level can mitigate airport users' burden, encourage competition between airlines and further reduce airfares,[4] and result in politically preferable levels of return being earned by the regulated airport. Second, the government may decide to adopt a particular regulatory approach prior to privatisation of the airport in order to maximise sale proceeds. The Australian government's decision on moving to the dual till for Sydney Airport was regarded as one case (CCUK, 2002, para. 2.72). Thirdly, the distributional effect has played a critical part. If airlines pass increased charges (as a result of adopting the dual till) onto passengers, passengers might have to bear higher airfares, and thus rents would be transferred from passengers via airlines to the airport shareholders. These rent transfers may not be socially or politically acceptable. Finally, price-cap regulation (implying one specific approach adopted) may limit competition between airports. One example is Manchester Airport in the UK where is currently under price-cap regulation, while its competitors (Liverpool and Leeds/Bradford Airports) are not. CAA (2003b, para. 2.6) states that 'the case for moving to a dual till in future would be substantially stronger ... if it became clear that increasing competition in practice to Manchester seemed more likely to best achieve the CAA's statutory objectives than tightly binding price cap regulation'. This illustrates that the adoption of one specific approach may base on the consideration of encouraging competition between airports.

4. Determining criteria adopted by regulators to decide the regulatory approach

The single-till approach is still widely applied across the world, although some countries have adopted the other approach. For example, the Australian Competition and Consumer Commission (ACCC, 2001b) in 2001 accepted Sydney Airport's proposal to adopt a dual-till approach. The UK CAA (2002b) has ever recommended a dual-till approach to the Competition Commission (CCUK). In the US, a study in 1998 revealed that the dual till was applied by 41% of the US large airports (Graham, 2001, p. 119). The Hamburg Airport is also regulated on the basis of the dual-till principle.

In formulating their final determinations on which model to adopt, recent experience indicates that regulators have tended to incorporate a wider range of non-economic considerations rather than basing their judgements on a rational appraisal of the advantages or disadvantages of single-till and dual-till approaches. Some of these non-economic factors are discussed in the following sub-sections

4.1 Regulator conservatism

The UK CAA (2003a, para. 1.6) states that its statutory objectives are to promote economic efficiency and users interest and to impose minimum restrictions on regulated airports, as well as to take into account international obligations. The fact that the CAA (2002a, para. 17.5–17.7) recommended a

[4] However, Starkie (1998, p. 112) argues that the fact that landing charges at congested airports are less than the market-clearing price (and sometimes the cost of supply) does not mean that air travellers necessarily enjoy cheaper airfares. Instead, airlines usually tend to charge what the market will bear and earn excess profits. The economic rent is hence transferred from the airport to airlines.

revised regulatory cost base[5] to replace the single till generally reflects the dual till's potential superiority in economic efficiency and the CAA's intention to fulfil its statutory objectives. However, CCUK (2002) in providing advice to the CAA, concludes: (i) no evidence shows that the dual till would perform significantly better than the single till in terms of dynamic efficiency or in the timing and level of capital investment; (ii) improvements in allocative efficiency as a result of adopting the dual till are limited; (iii) the benefits of applying the dual till are offset by increases in average airfares; and (iv) a substantial transfer of income from airlines (and/or passengers) to airports can potentially undermine regulatory credibility and create regulatory uncertainty. Following an extensive consultation process, the CAA (2002b, para. 2.3–2.7) finally decided to abandon its original recommendation of the dual till and retained the single till by excusing that it lacked the necessary support for change from the CCUK and airport users. Nonetheless, the CAA stated that it 'considers that while the case for moving to a dual till approach is not sufficiently strong at present ..., it should not rule out for the future should the balance of arguments and evidence change.' This is an indication of conservatism on the part of the regulator in that the main reason for retaining the single-till was not based on the merits of the regulatory approach itself, but that it could not present strong quantitative evidence to prove that a dual-till approach is preferable to a single-till. It also implies that the regulator would prefer maintaining a single till rather than making changes that might arise opponents' arguments and cause risks of regulatory failure.

4.2 Tendency in culture of economic regulation to minimise increases in charges and profits earned by regulated airports

As argued in Section 3.3, if moving from a single till to a dual till, the level of aeronautical charges would probably rise $(q/p - 1)\times 100\%$. This shows that the magnitude of such an increase depends on the cost and revenue structure of the airport. For example, according to the UK CAA's separation rule of aeronautical and non-aeronautical assets, in 2000/01 Heathrow Airport earned a 7.3% return on aeronautical assets (and 11.6% on non-aeronautical assets) with a 9.5% return on total assets (CCUK, 2002, Table 2.5). If a dual till was adopted, assuming aeronautical activities should earn a 9.5% return (i.e. Heathrow's actual overall return), the aeronautical revenue requires an increase of less than 7.6% and the overall return across all airport activities would rise less than 1.1%. If the allowable return on aeronautical assets were 8.6% (i.e. BAA London Airports' overall return), aeronautical charges would only need to increase less than 4.5% and the overall return would rise only 0.6%. The effect of such a 7.6% (or 4.5%) increase in aeronautical charges on airfares is up to £0.40 only, even thought all increases in charges are passed by airlines onto passengers. Therefore, the CCUK's argument that a dual-till approach would raise airfares is indeed correct, but its effect, at least for Heathrow Airport, is unlikely to be significant. The CCUK's position may in fact be based on a culture prevalent within economic regulatory institutions in the UK, which has tended to focus on minimising increases in regulated charges and by implication in the level of returns. For example, the Monopolies and Mergers Commission (replaced by the CCUK in April 1999) stated in the 1996 BAA review that 'to abandon the single-till approach and to base charges on costs of supplying airport facilities would allow BAA to make very large profits on its commercial activities, since we do not have the power to introduce any windfall tax on such profits' (CAA, 2000, para. 2.24). If a higher-than-acceptance (overall) return (which is likely to be induced by a dual till) is really the concern, the regulator may impose a lower permissible return on regulated services, a more rigorous requirement of service quality and/or additional obligations on capacity expansion in order to drive the excess returns away. However, the final decision revealed that the UK regulators chose to maintain the single till.

[5] That is, a dual till with a widened regulatory scope as opposed to a 'pure' dual till that includes aeronautical services only, or alternatively it can be deemed as a single till with a narrowed regulatory scope as opposed to a 'pure' single till that encompasses all airport services.

4.3 Other motivations

In privatising airports, the national government, as shareholder and regulator, may consider adopting a dual-till regime prior to the sale in order to optimise proceeds. For example, in 2000 Sydney Airport proposed to move towards a dual-till system that entailed a 130% increase in aeronautical charges. The ACCC (2001b) in its adjudication in May 2001 agreed a 97% increase (partly because of the adoption of a dual till) for Sydney. No doubt, such an allowable increase in charges, doubled with the removal of direct regulation in July 2002, has resulted in a higher sales proceeds. The Australian government received A$5.6 billion for Sydney Airport compared to the A$4–A$5 billion analysts had predicted.[6] The CCUK (2002, para. 2.72–2.73) observes that the cases for applying the dual till in Australia and Europe are partly because of providing assistance to privatisation (or in turn, maximising the sales proceeds of privatisation). However, these motivations for adopting dual-till regulation needs not always apply. In the United States, for example, adoption of the dual-till regime (compensatory method) is due to the unique operational circumstances of airports where airlines often either own or lease passenger terminals. Under these circumstances, airlines are the recipients of non-aeronautical revenue and hence airports, in order to break even financially, must recover aeronautical cost from aeronautical charges.

The use by airlines of considerable lobbying muscle by powerful airline industry organisations such as IATA[7] can also have the effect of exerting considerable pressure on regulators. Extensive consultation periods also provide opportunities for airlines to present their opinions and lobby for a favourable outcome.[8] These are the factors sometimes affecting regulators.

5. Alternative approaches to the full application of the dual-till and single-till approaches

Recognising the deficiencies of the single-till approach (particularly for congested airports), some economists have advocated reforming the regulatory approach (CAA, 2002a; Starkie and Yarrow, 2000). However, the main obstacle to switch the regulatory approach from the single till to the full application of the dual till (i.e. costs of all aeronautical services are required to be recovered by aeronautical charges at once) is the probable high increases in aeronautical charges and the subsequent opposition from users. In order to earn political and user acceptance, five alternatives to the full application of the dual till and single till have been considered. Table 1 briefly compares their features.

Table 1
The features of five alternatives compared to the full application of the dual-till approach

Alternatives	Re-valuating aeronautical assets	Redefining regulated services	Applying the dual till to new investments only	Adjusting the allocation of common costs	Allowing users to secure a stake in the airport
Under the single-till or dual-till approach	Dual	Dual	Single	Dual	See note
Value of regulatory asset base (RAB)	Less	More	More	Same	Same

[6] Air Transport Intelligence (ATI) news, 'Australia sells Sydney Airport for A$5.58 billion,' 25 June 2002.

[7] For example, IATA has several times presented their opposition to the dual till in the cases of reviewing Sydney Airport's aeronautical charges and BAA London Airports' price caps.

[8] For example, airlines at least had four opportunities to present their views in regard to the regulatory approach in the last review of price caps on BAA London and Manchester Airports.

Required aeronautical revenue to recover aeronautical cost	Less	Less	Less	Less	Same
Level of aeronautical charges	Lower	Lower	Lower	Lower	Same

Note: If non-aeronautical services were separated from the airport and operated by an independent company, the airport would no longer operate non-aeronautical services and then the selection between the single till and dual till would not be an critical issue.

5.1 Re-valuating the airport's aeronautical assets toward their market values

The market value of an asset is often at variance from its book (accounting) value. As aeronautical activities are usually less profitable or even loss-making, the market value of these assets is lower than the book value. Hence, a discount on the book value of aeronautical assets can be imposed. Aeronautical assets are therefore valued on the basis of their profitability rather than historical costs. As their book value has been discounted (i.e. value of RAB has been reduced), the required aeronautical revenue to recover aeronautical cost of capital, if the dual till is adopted, is less than that if the book value had been used. Devaluating RAB may be more acceptable to users as this can lead to a lower increase in charges. However, the CCUK (2002, para. 2.201) argues that the effect of this approach to deriving a lower dual-till price is broadly to replicate the pattern of charges of the single till.

5.2 Re-defining the scope of regulated services

The conventional approach to airport regulation involves defining the scope of those activities to be regulated to include aeronautical charges. If one of the objectives of regulation is to prevent the abuse of market power by the airport, then it therefore seems more appropriate that economic regulation should extend or encompass those activities in which it is able to exercise market power.

The UK CAA (2002a, Annex–RRCB allocations) defines those activities associated with airport market power as being necessary for the operation of airline but unable to be economically supplied, produced at another airport or outside the airport perimeter. The UK CAA definition extends the scope of regulation beyond the traditionally defined aeronautical assets to encompass check-in desks, aircraft refuelling facilities, aircraft maintenance facilities and access for providing catering services. These so called 'non-aeronautical monopolistic-bottleneck' services are usually more profitable than aeronautical activities.

If the dual till is adopted (and non-aeronautical monopolistic-bottleneck are included with aeronautical services in the same till), profits generated by non-aeronautical monopolistic-bottleneck services may offset potentially high increases in aeronautical charges that would have occurred if the conventional definition of the scope of regulated services had been adopted. For example, in Australia, the ACCC (2001a) recommended that the scope of regulated services should be extended so that around A$20 million of annual car-parking and other aeronautical-related revenue would be transferred to reduce 'stand-alone', cost-based, aeronautical charges (PC, 2002, p. 374).[9]

5.3 Applying the dual-till approach to new investments only

[9] However, in April 2001, the Australian government directed the ACCC (2001b) to implement a 'pure' dual till (i.e. only fundamental aeronautical services were taken into account, without consideration of aeronautical-related services) at Sydney Airport (Direction No.22).

Applying the dual till to new capacity investments can better incentivise regulated airports to expand capacity because the airport at least can fully recover its costs of new capacity from aeronautical charges. This is in contrast to situations where a single till is continued and only partial costs of new capacity can be recovered from aeronautical charges. In the long run, all aeronautical assets will gradually be replaced by new investments and the dual till will eventually be applied across all aeronautical services. This mechanism can spread out the sharp charge increases caused by a sudden switch to full application of a dual till. Major airports in Australia had adopted this alternative for the first five years of post-privatisation period (PC, 2002). New capacity investments, however, may also account for a substantial share of RAB and could induce a considerable increase in aeronautical charges. To a lesser extent, there also appears to be some degree of arbitrary allocation of new investments' assets between aeronautical and non-aeronautical resources. Users of existing facilities will probably cross-subsidise others using new facilities, if the airport cannot separate the former group of users from the latter.

5.4 Adjusting the allocation of common costs

In applying the dual-till approach, guidelines are needed in order to allocate costs and revenues between regulated and non-regulated tills. Opponents of dual-till pricing have argued that a degree of discretionary or arbitrary judgement is needed in allocating common costs between both tills. Furthermore, the required effort and time involved in allocating costs between both tills raises the costs of economic regulation. However, by adjusting the allocation of common costs between both tills, i.e. allocating additional common costs to non-regulated activities, may offset the required increase in regulated charges that would have been implemented without changes to the allocation of common costs. However, the effectiveness of this alternative would be limited, since the extent to tune the allocation of common costs could be very small.

5.5 Allowing airport users to secure a financial stake in the airport

One mode of compensating airlines for paying higher charges induced by a dual till is to allow airlines to secure a financial stake in the management of airport non-aeronautical activities. Airlines can therefore enjoy the profits and share the risks of operating non-aeronautical facilities. In the US, Australia and New Zealand, for example, some airlines own and operate passenger terminals (Starkie, 2001, p. 132) where the most non-aeronautical profits are generated. One possible deficiency in this arrangement is that entry access may be blocked, in particular for new entrants.[10] However, in these cases, it would be incumbent on the government under national competition and fair trading laws to ensure that access is not denied. Another deficiency is that those airlines operating terminals may not develop non-aeronautical business to its full potential. This is because first, conflicts of interest could arise in terms of the conflicting space needs of the airline and the retail concessions, and second, the airline may not possess the required skills and knowledge to full exploit non-aeronautical revenue.

Starkie (2001) suggests another arrangement, which is to demerge the airport's non-aeronautical business into a separate company. It is then established as a joint venture between the airport and airlines. This type of joint venture would maintain existing incentives for the airport to increase aeronautical output and provide incumbent airlines with similar incentives. The airport can reap more revenue from higher aeronautical charges that will be allowed under a dual till. Airlines can enjoy the benefits of operating non-aeronautical facilities. Higher aeronautical charges at congested airports could encourage larger aircraft and lead to an increase in the average number of passengers per aircraft

[10] For example, those airlines that own and operate their own terminals can constrain other airlines from using these terminals. This may create obstacles to new entrants obtaining access to the airport.

movement (because higher landing charges might lead larger aircraft to operate more cost-efficiently as landing charges can be shared by more passengers). Because of this effect, more passengers would be brought into and use the airport, non-aeronautical turnover would increase, and ultimately both parties could share the increased non-aeronautical profits. It could be a net overall gain to the airport after allowing for the lump sum transfer of enough equity to compensate the airlines for any increase in aeronautical charges. If the airport ownership rule is constrained, such as in Australia where the airline's ownership of the airport is limited up to 5% (PC, 2002, p. XIX), an obstacle to the above arrangements will be created.

6. Future prospects

Worldwide airline passenger numbers have more than doubled over the past twenty years, while the expansion of runway, stand and/or terminal capacity has not kept pace with the growth in demand for slots, leading to capacity shortages (DotEcon, 2001, pp. 1 and 5). It is thus urged that airport pricing should move toward efficient capacity management and enhance incentives to expand capacity. Zhang and Zhang (2003) develop a multi-period model which allows capacity being expanded by discrete units in order to derive the optimal timing of expansion—the time when the perceived benefits (e.g. the gain in operating profits) of additional capacity just outweigh the cost of capital for the expansion. As an airport's overall return is likely to be higher under the dual till, the timing of capacity expansion would be earlier under the dual till than under the single till. In incentivising capacity expansion in time and providing correct pricing signals for incremental capacity, a move to the dual till is recommended before excess demand becomes severe. The longer the single till is maintained at congested airports, the more excess demand grows and the less effectiveness of moving to the dual till. This is because demand inelasticity will become significant and price mechanism will weaken as excess demand grows.

In order to urge capacity expansion, the CAA (2003a) has incorporated both the air traffic movement incentive condition for Heathrow Airport[11] and the triggers condition to prompt capital expenditure for Heathrow and Gatwick Airports into the price-cap formulas since April 2003. This shows that incentives for airports to expand capacity can also be provided through particular arrangements on price caps, rather than relying just on adopting the dual till. Further attempts to develop superior alternatives to both approaches, avoiding disputes on the singe till versus dual till, are foreseeable.

The proposal that allows the airport immediately receiving benefits of expanding capacity is also emerged. It is argued that new slots created by the airport could be auctioned and the proceeds could accrue to the airport. Incentives for the airport to expand capacity will be enhanced, particularly for those airports now facing severe excess demand. However, who owns the property rights to slots has not been clarified and is therefore subject to a considerable degree of legal uncertainty and ambiguity. Present EC regulation also prohibits the sale of slots. It is still questionable whether the airport should enjoy the scarcity rents (beyond the building costs of new capacity), especially where capacity is limited by planning and environmental constraints and the scarcity value of new capacity will be significantly higher than the accounting costs. To put this proposal in place also requires reforming the slot allocation mechanism and establishing the secondary slot trading market.

The dual-till approach (perhaps a modified version) can be a transient arrangement for deregulation. The Australian case provides one example for this, though the effectiveness is unclear (Forsyth, 2003, p.

[11] However, this air traffic related movement incentive at Heathrow would not implement until the introduction of an aerodrome congestion term as part of the remedy to the adverse finding by the CCUK on service quality (CAA, 2003a, para. 9.1).

34). If a sudden switch from the single-till regulation to deregulation is undesirable, a temporary move to the dual-till regulation can be an option.

7. Concluding remarks

The decision of the regulatory approach, between the single till and the dual till, is a mix of diversified arguments, reasons and considerations. This issue is mainly due to the phenomenon that the regulatory approach is usually unspecified in the airport economic regulation acts. In order to achieve lower aeronautical charges and minimise regulated airports' excess return, regulators tend to apply the single-till approach, which might inadequately extend the regulatory scope into non-aeronautical business (which are generally falling outside the current definition of regulated services). It is thus recommended that the regulatory approach, single-till or dual-till, should explicitly be specified in the relevant legislation or, at least, the conditions of adopting any approach should be specified, rather than decided by the regulator's discretion.

Demand for aeronautical services is one type of derived demand from airlines' demand for providing air travel services to passengers. To derive ideal regulatory outcomes, it is essential to empirically derive approximations of demand elasticity for access to an airport. For those airports with substantial excess demand, a dual till might potentially result in better outcomes in relation to economic efficiency but its effectiveness would be limited if price inelasticity is significant. Under such circumstances, a possible solution is further toward market-clearing pricing. There is scope of further research in these areas.

Appendix

First of all, if the single-till approach is adopted and the airport sets its aeronautical charges at the maximum level determined by the regulator, the airport will just break even on providing all airport services (including reasonable returns) as Equation (1). The aeronautical deficits and non-aeronautical profits are then shown in Equations (2) and (3)

$$\pi^S = TR^S - TC^S = \left(R_A^S - C_A^S\right) + \left(R_N^S - C_N^S\right) = 0 \tag{1}$$

where R_A^S = Revenue of aeronautical services under the single-till approach;

R_N^S = Revenue of non-aeronautical services under the single-till approach;

C_A^S = Cost of aeronautical services under the single-till approach;

C_N^S = Cost of non-aeronautical services under the single-till approach;

$TR^S = R_A^S + R_N^S$; and

$TC^S = C_A^S + C_N^S$.

$$\pi_A^S = R_A^S - C_A^S = \frac{p-q}{p} R_A^S = \frac{p-q}{q} C_A^S \quad (p < q) \tag{2}$$

where $p = R_A^S / TR^S$; and

$q = C_A^S / TC^S$.

$$\pi_N^S = -\pi_A^S = \frac{q-p}{p} R_A^S = \frac{q-p}{q} C_A^S \quad (p < q) \tag{3}$$

If switching to the dual till, aeronautical revenue, R_A^D, will require recovering aeronautical cost, C_A^D, assuming that aeronautical demand is significantly enough for the airport to earn such revenue and that

aeronautical cost under the dual till is the same as that under single till (this implies that the consumed quantity of aeronautical services under the dual till is equal to that under the single till)[12]. This is indicated as Equation (4). Aeronautical revenue and charges, therefore, have to rise by $(q/p-1)\times 100\%$ if moving from the single till to the dual till. This is shown in Equation (5). The larger the value of q/p (or the larger difference between q and p), the higher the aeronautical charges under the dual till (than under the single till).

$$R_A^D = C_A^D = C_A^S = qTC^S = qTR^S \quad \left(?\ \pi_A^D = 0 \text{ and } C_A^D = C_A^S\right) \tag{4}$$

$$\frac{\Delta R_A}{R_A^S} = \frac{R_A^D - R_A^S}{R_A^S} = \frac{qTR^S}{pTR^S} - 1 = \frac{q}{p} - 1 \tag{5}$$

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A NOTE ON WELFARE EFFECTS OF DIFFERENT SYSTEMS OF AIRPORT CHARGES

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ABSTRACT

According to theoretical predictions, the application of peak-load pricing to utilities usually results in higher levels of welfare and is recommended on this basis. In what concerns airports, this pricing system is adopted by some of EU airports, in order to alleviate congestion by means of demand shifting, while others charge according to aircrafts' weigh. This paper provides an insight on the effects on welfare of both pricing systems. Within the framework of a vertical differentiation model, and using a two-stage game with two airlines and one airport, I find that peak-load pricing actually decreases consumer surplus and welfare, but is the preferred system for the airport and for the low quality firm. These results are opposite to previous ones, and some particular features of the model, and of the airports' particular case, account for this difference.

Keywords: *airports, peak-load pricing, welfare.*

1. Introduction: The application of different price systems and the purpose of the paper

Most EU airports charge airlines for landing and taking-off facilities mainly according to the weigh of the aircraft, so that larger aircrafts pay more than small ones. In particular, these prices don't change with the season or the time of the day[1].

On the contrary, other airports in the EU charge different tariffs according to the time of the day, or to the season, with higher charges in peak hours. This peak-load pricing, which is very often applied in other industries, is used in airports like Heathrow, Gatwick, and Dublin, among others.

The purpose of this paper is to find which price system is better, namely in terms of welfare and consumers' (passengers') surplus. With a simple model using alternatively both pricing systems, I try to check if the arguments for higher peak-hour pricing are sustainable within the context of airports.

Policy implications of the choice between the two systems of charging facilities are, in my, opinion, quite relevant. As it is known, grandfathering rights still persist in the UE. These rights mean that any airline that uses a slot at least in 80% of the times in one season is entitled to use it for the next season. In busy airports, namely in those that are congestioned at certain times of the day, the best timetables are kept by incumbent airlines. These flights offer a better quality because timetables are more suitable for passengers, as they may, for instance, attend to a meeting somewhere in Europe, leaving in the morning and coming back on the same day, and don't have to stay overnight (with the consequent expenses in accommodation), or as they don't have to fly at a too early or too late hour.

1. Most of these airports have noise charges, which are higher during night time. But, even at this time, charges vary mainly according to the aircraft noise characteristics, as classified by ICAO. Besides, night surplus applies only between around 22:00 and 5:59, which is quite different from peak-off hours. For instance, at Dublin airport, peak-off time, during summer months, extends from 00:00 to 05:59, from 08:00 to 08:59, from 15:00 to 16:29, and from 21:30 to 23:59.

Therefore, new entrants, when they candidate for a slot near the airport co-ordinator, will probably get the worst times of the day, and hence, will have a smaller demand. Else, if they aim to increase their demands, they must push down prices, and, of course, profits.

Because of grandfathering, flights from and to the same airport become differentiated products, with different qualities, depending on their timetable. Price competition is relaxed, with consequent damages for passengers. Anyway, this would be necessary at busy airports, even if the airlines exchange places, and if the best slot would be offered to the new entrant. But grandfathering rights assure that the incumbent airline keeps the best flights. If airport charges aren't differentiated by the time of the day, airport costs are equal for both airlines and new entrants are penalised on the supply side. Rather, the new entrants may be benefited if off-peak prices are smaller.

Consequently, there are important implications of peak-load pricing on competition grounds: the flights' price differential may become larger, shifting the demand from peak-load to peak-off flights, and the new entrants may be in better terms in what concerns demand and costs, when comparing with a simple weigh-based pricing scheme.

In this context, how much are consumers and welfare affected, and by which means? This is the main question of this paper. Other questions, as the redistribution of profits among the three firms, and the effects on demand are also relevant here.

The paper is developed as follows. In section 2, I make a very brief survey of the main conclusions of peak-load price theory, and of other models and general recommendations of this policy. Some evidence on both pricing systems in EU airports is shown in section 3, in order to gather the dimension of the question. In section 4, the main features and assumptions of the model are presented, while the cases of equal and of differentiated prices are developed through sections 5 and 6. Finally, in section 6, I comment and interpret the results of the model, and compare them to previous works, as referred in section 2.

2. Theory and practices of airport tariffs

The theory of peak load pricing was mainly developed by Boiteux, though it is argued that the analysis of the problem goes back to 1926, with the studies of Bye (Crew, Fernando and Kleindorfer, 1995). Evidences from some industries, like electricity and telecommunications, showed that consumers used these goods more intensively at some hours of the day, while in other times consumption levels became low. This brings a problem of excess capacity. Marginal cost is higher at peak-load times, as it includes a capacity marginal cost, and lower at peak-off times, where only variable costs are added for an extra unit of consumption.

From the point of view of welfare, prices should reflect these differences on marginal costs, and be higher at peak-load hours (Tirole and Laffont, 1999). At lower demand periods, there's an excess of capacity, and keeping it leads to inefficiency, which has a cost, and pricing should mitigate this inefficiency (Crew, Fernando and Kleindorfer, 1995). These considerations establish the basis for setting different prices at different hours of the day.

This price scheme became very usual in industries like electricity and telecommunications.

Official recommendations towards applying peak-load pricing to airports were quite strong through the seventies and the eighties, but seem to have been progressively losing its importance (Starkie, 2001). In fact, recent documents issued by the EU Commission don't refer the matter, though they are quite concerned with other subjects the effects of which approach the objectives of peak-load pricing, such as the problems of grandfathering and slots' trading.

However, the Commission recommends that airports should not discriminate their charges, though allowing for differences in prices, as long as criteria are objective and non-discriminatory (European Commission, 2000). Apparently, the criteria used for peak-load and peak-off doesn't discriminate among airlines. But, with the grandfathering rights of the first comers, the picture seems to change. Anyway, this practice is, of course, allowed in EU airports.

Recently, and as the problem of airport congestion has become more serious, many opinions advise again this system in order to avoid, or at least mitigate, congestion problems like delays and queuing. Gurantz (2001) states that peak-load pricing would lead to fewer delays, and more efficiency. Higher prices would split passengers towards peak-off time, and this would lead to a better allocation of flights. As reported by Reuter (2001), Brueckner supports the system, based exactly on the same considerations of higher flight tickets, and consequent shift of airlines and passengers to peak-off hours. These considerations are common to other utilities' basis for using this price system.

Opinions against this system are less frequent. Among them, it is worth referring the US-CAWA (2001) advice, as it becomes important in the context of this paper. They state that peak-of pricing has anti-democratic consequences to people who can't afford flying during peak daily hours. Additionally, the demand shift means that more passengers will have to wait longer for connecting flights, spending more time at airports, and more money on hotels.

Models testing both pricing systems for welfare purposes are scarce, as far as I know. In a recent work, Daniel (2001) uses evidence from Minneapolis- St Paul airport to simulate the effects of congestion pricing in welfare. He finds that overall net surplus increases with this system, for the three patterns of demand elasticity he uses. The simulations are made using costs that include those derived from layover time, queuing delays and the probability of losing connection flights in hub airports. Net surplus mainly increases by the reduction in these costs.

Crew, Fernando and Kleindorfer (1995) provide an interesting observation when noting that, in what regards airports, peak-load prices haven't the expected effects on demand shifting because of slots' grandfathering. They argue that the impact of this pricing system on demand (and, consequently, on demand shifts) is quite small while this right prevails, and that only overall reforms on slot trading may provide a basis for applying efficiently any congestion pricing policy.

3. Some evidence

In order to seize the importance of this problem in the European Union, namely about the magnitude of price differentials under both systems, I tried to check with some airports[2] about their pricing system and about the fares they charge airlines. Prices for four UE airports are displayed in Table 1. Frankfurt, Orly and CDG practice only a MTOW price, which differs with the weigh (and size) of aircrafts. Dublin also applies this system, but differentiates much less among aircrafts, and adds peak-load prices, which are 300% higher than those of peak-off hours. This margin is near the ones existing in other busy airports. For instance, in Heathrow peak fees exceed off peak ones by 230%, while in Gatwick this difference goes up to 300% (Ewers, 2001).

I chose five aircrafts of different sizes. To find the number of passengers by aircraft I used Lufthansa average patterns, with a 100% occupation rate. Prices include movements (take-off or landing), aircraft handling, parking (up to one hour), and noise charges. The first two charges are the most important ones. At Frankfurt airport, they represent 92% of the total price, while noise charges account only for 7% for a Boeing 747, and 3% for an Airbus 340. Passenger fees are excluded, as they aren't related to the weigh of aircrafts.

At Frankfurt and at Paris' Orly and CDG airport fees are clearly differentiated with the weigh of the aircraft. Average deviations are, respectively, of 2.4 and 3.4, much higher than the same value for Dublin (1.4 peak and 0.5 off-peak). Dublin airport practices a strong differentiation between standard and peak-off times, but exhibits a low level of MTOW differentials. Besides, peak-off prices are very small, probably reflecting very low (or almost zero) marginal costs of landing and taking off.

2. I contacted several airports, including Portuguese ones, asking about their system of charging. The airports of Orly and CDG, and of Frankfurt, answered my questions, while tariffs for Dublin airport can directly be found in internet. Some of the inquired airports didn't reply, and in this case are London airports, that charge peak-load prices.

Table 1: Prices per passenger at some airports, in euros

	Frankfurt Airport	Orly and CDG
Boeing 747-400	**4,5**	**8,4**
Airbus A340-200	**7,3**	**10,6**
Airbus A319	**2,2**	**4,4**
Boeing 737-500	**2,5**	**4,3**
Canadair CRJ 700	**1,4**	**2,3**
Average Deviation	**2,4**	**3,4**

	Dublin Airport		
	Standard	**Off Peak**	**Standard/ Off-Peak**
Boeing 747-400	**3,9**	**1,3**	**2,9**
Airbus A340-200	**5,0**	**1,7**	**2,9**
Airbus A319	**2,1**	**0,9**	**2,3**
Boeing 737-500	**2,0**	**0,4**	**4,7**
Canadair CRJ 700	**1,9**	**0,6**	**3,4**
Average Deviation	**1,4**	**0,5**	

4. The model

In the second stage, I use a duopoly model in a vertical differentiation setting. The two firms are the incumbent, who sells the highest quality (denoted by the subscript "**2**"), and the new entrant, supplying the lower quality (denoted by subscript "**1**"). This new entrant is supposed to have entered successfully in the industry, and, so, any game of entry is ruled out. The product is a flight with the same departing and arriving point, and taking place on the same day. Both airlines sell the same flight, though at different times of the day, the incumbent at peak hours (which accounts for its better quality), and the new entrant at off-peak hours. Due to quality differentiation, the prices of the flights are, of course, different.

Contrarily to the usual hypothesis of vertical differentiation models, quality is an exogenous variable, as the airlines can't change it. So, there is a set quality for peak time flights, which consists on the comfort passengers are entitled to, in the terms described above, if they buy these flights. I denote this quality by "**a**", and I set the worse quality equal to the unit, so that "**a**" is a measure of the quality differential, **a>1**.

Airlines are supposed to use aircrafts with the same weigh and the same size, so that there aren't differences due to MTOW charging.

Besides the two airlines, there is the airport, which I suppose to be a private firm. The discussion of this hypothesis is done below. I denote the airport variables by the subscript "**A**".

The two airlines bear only the costs that airports charge for movements, luggage handling, parking, etc. This is a rather simplifying hypothesis. Indeed, these costs are very small when compared to other flying costs. These latter may be variable or fixed. As for variable costs, there is no problem in ignoring them, as the prices may be understood as price-cost margins, which is usual in vertical differentiation models. The exclusion of fixed costs hasn't much importance, too. Indeed, these costs don't account for the solutions of the Bertrand game in the second stage, and, so, for the airport demand and fees determination in the first stage. The introduction of other costs would only change airlines' profits.

Anyway, the reasons for including only airports' tariffs in airlines' costs are (i) to simplify the model and make results comparable and understandable, and (ii) because the model focuses precisely on these costs, and the price the airport charges to airlines is an endogenous variable of the game.

I also exclude fees directly charged to passengers, as they aren't part of airlines' costs, but are directly paid to airports.

As for demands, they are determined in a Gabszewicz-Thisse vertical differentiation setting, using the formulation of Motta (1993)[3], which makes it easier to compute the values of variables. So, there is a number of potential consumers (passengers), uniformly distributed according their marginal willingness to pay for quality, which is represented by **v**, and **v** is set between the limits of "**0**" and "**1**".

3. Calculus was developed in SW3, and may be obtained by request to the author.

Denoting flight prices by p_1 and p_2, respectively for the lower and the higher quality flights, the demands for flights will be:

$$y_1 = (p_2 - ap_1) / (a-1) \quad \text{and} \quad y_2 = (a-1+p_1-p_2) / (a-1)$$

Demands are interdependent, as products are considered as differentiated. Besides, they are derived demands. As will be noted and developed in the last section of the paper, these demand functions differ much from the ones used in other works on congestion prices.

As for the airport, I suppose that it charges a price **P**, measured as a price per passenger, for the use of its facilities. Besides these revenues, it also gets those originated by retail and restaurant activities, car rental, exchange, etc. These activities are very important, and couldn't be ignored. For example, in Heathrow and Gatwick, they account for about 60% of all airport revenues.

I normalize each passenger's expenses on retail and restaurants to the unit, and then these expenses become equal to the number of passengers, y_1+y_2. I use a short run approach, as it seems to be more convenient. In fact, an airport's expansion is a very slow process, on account of technical, environmental, political, and other issues. Therefore, and for simplicity, the airport bears only a fixed cost, **C**.

I suppose that airports maximise profits, which means considering the airport as a unregulated private firm. Here, it is important to mention that some EU airports are privately owned, such as Heathrow, Gatwick, Stanstead, Fiumicino, in 100%, and Vienna, Copenhagen, Dusseldorf, among others, in more than 50%, some are locally owned, while others are state owned. For these latter, welfare (instead of profits) maximisation would be more adequate.

In order to capture the welfare effects of airport fees' differentiation, I apply the model to two cases. In the first one, prices aren't differentiated. In the second one, the fees airlines pay are different according to the time of the day.

The game is developed in two stages. In the second stage, airlines choose their flights prices, depending on the fixed quality and on the airport prices for using landing and

taking off facilities. Thus, we get their demands for using the airport. In the first stage, the airport determines its facilities' prices, using these demands.

5. The case of equal prices

This case applies to airports that charge movements, parking and handling of passengers and luggage, according to the so-called MTOW, the weigh of the aircraft. This is the case of Frankfurt, Orly/CDG, Fiumicino, and many others.

In this situation, the airport charges the same price by passenger, **P**, in every movement, to similar aircrafts, whatever may be the time of the day and/or of the year.

With y_1 and y_2 as defined above, and being the airport's fees the only costs, the airlines' profits, Π_1 and Π_2, respectively for the new entrant and the incumbent, are:

$$\Pi_1 = (p_1-P)\,(p_2-ap_1) / (a-1) \quad \text{and} \quad \Pi_2 = (p_2-P)(a-1+p_1-p_2) / (a-1)$$

In the second stage, both airlines maximise profits, in a Bertrand game. Reaction functions are upwards sloping, as expected, and have the expressions:

$$p_1= (p_2+aP)/2a \quad \text{and} \quad p_2=(a-1+p_1+P)/2$$

Solving these reaction functions there result expressions of Π_1, Π_2, p_1, p_2, y_1 and y_2, all depending only on **P** and on **a**.

The airport's profits are:

$$\Pi_A = P(y_1 + y_2)+ (y_1 + y_2)-C$$

The first term accounts for the revenues charged to airlines, and the second one for revenues of retail activities.

In the first stage, the airport maximises its profits, choosing the value of **P**, which turns out to be:

$$P= (a-1)/2(2a+1)$$

With this value of **P**, solutions for the other variables are computed, and they are shown in Table 1.

To account for welfare effects, consumer surplus, **CS**, and welfare, **W**, must also be computed. Consumer surplus will be[4]:

$$CS = \int_{p1}^{(p_1-p_2)/(1-a)} (v-p_1)dv + \int_{(p1-p2)/(1-a)}^{1} (va-p_2)dv$$

As for welfare, I use a standard measure, which is the sum of consumer surplus, the airlines profits and the airports' profits.

6. Differentiated pricing

In this section, I adjust the previous model in order to include higher charges for peak hours and lower prices in off-peak time.

As above, I suppose that the new entrant has the lower quality flight, and the incumbent airline has the high quality one. But now the airport charges P_2 to the incumbent, and P_1 to the new entrant, $P_2>P_1$.

The airlines' profits become now:

$$\Pi_1 = (p_1-P_1)\,(p_2-ap_1) / (a-1) \quad \text{and} \quad \Pi_2 = (p_2-P_2)(a-1+p_1-p_2) / (a-1)$$

The process is the same than in the precedent section. In the second stage the airlines maximise their profits on prices, from where result the airport's derived demands.

The expression of Π_A is now:

$$\Pi_A = P_1y_1 + P_2\,y_2 + (y_1 + y_2) - C$$

4. See Motta (1993).

In the first stage, the airport maximises its profits on $\mathbf{P_1}$ and $\mathbf{P_2}$, resulting:

$$\mathbf{P_1 = 0 \quad and \quad P_2 = (a-1)/2}$$

The value of $\mathbf{P_1}$ is apparently surprising. Why should the airport charge nothing (or almost nothing) in peak-off hours? But, after all, in these hours, there are no alternatives for using the equipments, which are fixed, so marginal cost is zero. The airport, though unregulated, chooses to price at short run marginal cost. Besides, by charging a very low (zero) fare to the new entrant airline, the airport gets more revenues from retail and other activities, which are usually higher than revenues from airport landing/ taking-off facilities. Notice that this evidence is present in the model's results. The price of retail activities was normalised to the unit. In the precedent section, the equilibrium value for **P** is smaller than one. And, in this case $\mathbf{P_2<1}$ for any $\mathbf{a<3}$, or for a certain limit of product differentiation.

Profits, prices and welfare were computed as explained above, and the comparison of results is displayed in Table 2.

7. Comments on results and concluding remarks

As it can be seen in Table 2, in the context of this model, peak-load pricing has a negative effect on consumer surplus and on welfare. This result is opposite to theory's predictions and to the ones of other models presented before.

Let's first see how a change from an equal price to a differentiated price system affects the three firms' strategies, leading to a lower level of welfare.

In the second stage, with different prices, the incumbent expects to lower its profits, as it bears higher costs, and inversely for the new entrant. Then, the first airline charges passengers higher prices for its flights, as it can't differentiate them more. Quality is fixed, so strategies based on an adjustment of the quality differential aren't practicable. Prices are the only variables airlines can manipulate. The best reply by the new entrant is to keep its price. Though costs are lower, its rival has raised its price, so, and as the reaction function is upwards sloping, $\mathbf{p_1}$ may remain the same.

In the first stage, the airport anticipates the airlines' adjustments towards a general price raise, and it will expect a lower demand, which might diminish its revenues. As costs are fixed, its strategy can only be based on revenues.

Table 2: Solutions for equal and differentiated pricing

	equal prices (**E**)	different prices (**D**)	comparison
$y=y_1+y_2$	$(5a+1)/2(4a-1)$	$(5a+1)/2(4a-1)$	$y^E = y^D$
p_1	$3(a-1)/2(4a-1)$	$3(a-1)/2(4a-1)$	$p_1^E=p_1^D$
p_2	$a(8a^2-a-7)/2(2a+1)(4a-1)$	$3a(a-1)/(4a-1)$	$p_2^E<p_2^D$
P	$(a-1)/2(2a+1)$		
P_1		0	
P_2		$(a-1)/2$	
Π_A	$((25a^2+10a+1)/4(2a+1)(4a-1))-C$	$((2a^2+9a+1)/4(4a-1))-C$	$\Pi_A^E<\Pi_A^D$
Π_1	$a(a+2)(a^2+a-2)/(2a+1)^2(4a-1)^2$	$9a(a-1)/4(4a-1)^2$	$\Pi_1^E<\Pi_1^D$
Π_2	$a(a+2)(8a^2+3a+1)(8a^3-5a^2-2a-1)/4(2a+1)^2(4a-1)^2$	$(2a+1)(2a^2-a-1)/4\ (4a-1)^2$	$\Pi_2^E>\Pi_2^D$
CS	$a(64a^4+84a^3+117a^2+50a+9)/8(2a+1)^2(4a-1)^2$	$a(4a^2+25a+7)/8(4a-1)^2$	$CS^E>CS^D$
W	$((192a^5+460a^4+355a^3+18a^2-49a-4)/8(2a+1)^2(4a-1)^2)-C$	$((28a^3+111a^2-27a-4)/8(4a-1)^2)-C$	$W^E> W^D$

But a lower demand affects the airport on two kinds of revenues, those from aircraft landing and other facilities, and those from retail and restaurant activities.

To lessen losses in retail and restaurant revenues, the airport prefers to lower $\mathbf{P_1}$ to a very small value (in fact, $\mathbf{P_1=0}$), which is somehow compensated by the increase in landing and taking-off facilities' revenues derived from the incumbent airline, as the new $\mathbf{P_2}$ is higher than the previous **P**. Hence, with the same demand as before, and as the rise in the price it charges the incumbent isn't offset by the decrease of $\mathbf{P_1}$, the airport gets now higher profits.

The new entrant's demand increases, allowing it to keep its price, while the incumbent's demand decreases. With a higher demand and lower costs, the new entrant experiments an increase in profits. The situation is inverse for the incumbent and Π_2 diminishes.

The number of passengers is the same, as the choice between buying, or not, a flight, depends only on **a** and $\mathbf{p_1}$, and this latter hasn't changed. But $\mathbf{y_1}$ grows, while $\mathbf{y_2}$ decreases. There is an effect of redirecting passengers (and flights) to peak-off hours, as theory predicts. This effect is quite obvious. What is new in this model is the fact that the airport anticipates this shift in its demand and adjusts the level of its prices in order to increase profits.

As a consequence of this strategy, this effect on demand is negatively reflected in consumer surplus. Consumers lose quality, as more of them have to fly at less suitable hours. This loss of quality and the rise in $\mathbf{p_2}$ account for a lower level of consumer surplus with differentiated prices. Welfare becomes also lower, as the decreases in **CS** and in Π_2 aren't offset by the increases in Π_1 and Π_A.

Then, the main conclusion of this paper is that, according to the results of this model, airport's prices differentiation hasn't all the expected effects that theory suggests. In fact, only the airport and the new entrant are better off with it. It was expected that the new entrant would see its demand and profits rise, and its costs decrease, and this happens in the context of the model. Apparently, the benefits for the new entrant should spread to consumers. But this is not so, as average quality is smaller, and more passengers have to take less suitable flights (and maybe to spend more money in hotels and other items). Besides, the incumbent airline adjusts by increasing its prices, but with a smaller demand and higher costs, experiments a decrease in profits. Higher prices for the best flights may alleviate congestion, but they also account for a lower consumer surplus.

Now I shall present a few points, which, in my opinion, are pertinent to explain the differences between my results and those of previous works. These differences are mainly due to the assumptions I use. Some of them may be simplifying hypothesis, but others are taken so that the model may capture some important features of the airports' case.

(i) An important assumption of my model is the number of firms involved in the game, as well as the role they play. In most of the works on peak-load prices' effects, there is a firm and a large number of consumers to whom the price system is imposed. But, when applying this price system to airport tariffs, on the demand side there are airlines and not directly consumers. And, unlikely consumers, airlines have their strategies. Besides, the airport plays an active role, and doesn't behave merely like a passively regulated firm.

(ii) The absence of regulation makes another difference. While congestion prices theory is built with the aim of regulating, this model assumes a private and non-regulated airport. The assumption may be somehow strong. Though many EU airports are private, and many more will probably be in the future, it is true that they are regulated, even if regulation may be questionable (Barbot, 2003). The introduction of price caps, or of other regulation methods, might provide interesting insights. Anyway, the model may be useful in the sense that de-regulation of utilities is an important question nowadays. And, in a game where the airport chooses the price system, regardless of regulation constraints, it would no doubt opt for peak-load prices.

(iii) Demand patterns play a crucial role on welfare results. Most works are based on the independence of demands. Williamson (1966) suggests that relaxing this hypothesis might provide a possible extension of his analysis, though graphic treatment would become unfeasible. I believe that using interdependent demands, both for flights and for airport facilities, is an interesting feature of a model for the airports' case. Besides, some more consistency is added, because, instead of using any *ad hoc* demand functions, they are derived in the context of vertical differentiation theory.

(iv) The next question is concerned with where we should introduce quality. In the model I present, welfare depends on quality, and quality is based on the benefits of flying at more suitable timetables. Then, when more passengers fly at peak-load periods, welfare becomes higher. This is quite different from Daniel (2001)'s model, where welfare is accounted mainly by delay and queuing time. This is a crucial point, and, by means of

different assumptions on quality, it is natural that results don't match. But my quality approach is the reason why the results of the paper quite agree with US-CAWA(2001)'s statement, referred in section 3. Indeed, US-CAWA refers to the loss of consumer surplus, in the part that is accounted by the loss of quality for peak-off hours' passengers. Then, the question is where to place passenger's quality, on the comfort of flying at suitable times, or on the conveniences of not having to wait. A model that would include both features is an interesting challenge.

(v) The role of grandfathering was stressed in the above-mentioned remark by Crew, Fernando and Kleindorfer (1995). They argue that grandfathering prevents demand shifting and that, as long as this practice prevails, the effects of congestion prices in airports are countervailed by it. I consider grandfathering in the model, as the incumbent airline has the best quality. But it could as well be the new entrant to have the higher quality slot, and results wouldn't differ. It really doesn't matter "who's who", or who sells the best quality good. Besides, in my model, demand effectively shifts, though total demand remains the same. If we would relax the grandfathering hypothesis, the game might be quite different, and, of course, interesting, but it had to involve slot trading, and quality costs of acquiring the best slots.

(vi) Finally, a few remarks on cost functions. In what concerns the airlines' costs, vertical differentiation models usually include quality costs, which increase with the level of quality. In the present model, these costs are neglected. In fact, quality here means flying at better hours, and the higher quality good becomes available not because the airline invests in quality, but because it has the best slots by means of grandfathering rights. These rights are costless, so there's no reason to include quality costs. But they may become opportunity costs, as the airline is entitled to keep the slot as long as it uses in at least 80%. This may mean some losses in peak-off seasons, obviously compensated by profits in peak-load seasons (otherwise, it wouldn't keep the slot). Then, the losses could be quality costs. Airports' costs are also simplified when considering only fixed costs. This is done in order to make the model easier to work with, but labour costs of luggage handling, air control, refuelling, and others, are probably a significant part of total costs.

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Theory and Practice in Aircraft Financial Evaluation

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Introduction

The world's airlines are continually challenged to deal effectively with uncertainty in the transport sector and the inevitable downturns faced by any business. These cyclical swings are exaggerated by the periodic need to replace older equipment with more modern aircraft. Financial innovations provide a certain number of solutions to the problem of matching transport capacity to the fluctuations of demand.

Financial theory as implemented in companies around the world provides a clear method for estimating the financial cost of investing in equipment such aircraft, an average of the cost of borrowing, or debt, and cost of invested funds, or equity. The Weighted-Average Cost of Capital (WACC) has been used in investment appraisal for over twenty years, and more recently, has been applied to corporate financial management, in techniques such as Economic Value-added (EVA).

The techniques used to value the financial viability of investments - from basic profitability, to Return on Investment, Net Present Value and Internal Rate of Return - are taught to hundreds of thousands of business students around the world every year. Many books and software tools are available to assist companies in valuing investments. Clearly, financial valuation has reached a mature stage of balancing theoretical correctness with practical usability.

So, what is the state of practice? Clearly there are positive points (many managers are familiar with the techniques), but on the other hand a certain lack of clarity in definitions can be detrimental to their proper use. In our work in the aviation industry, we find that there is considerable frustration with the limits of the theoretical responses to practical issues surrounding implementation.

The objective of this paper is to stimulate discussion, research and debate about potential innovations for practitioners in the aviation field. The scope of the paper - like the airline industry itself - is global, which means that we attempt to point up solutions for airlines in developing as well as mature economies.

Sources of airline capital and corporate valuation

In many countries, airlines have historically been viewed at least partially as an infrastructure investment, required to promote economic development and growth. This implies that for many governments, airline financing can be viewed as part of the state's overall infrastructure financing. Further, because of the strategic and military background of aviation, many of the world's airlines were initially financed using state funds.

In this historical perspective, the cost of financing investment in aircraft is the government's own cost of financing.

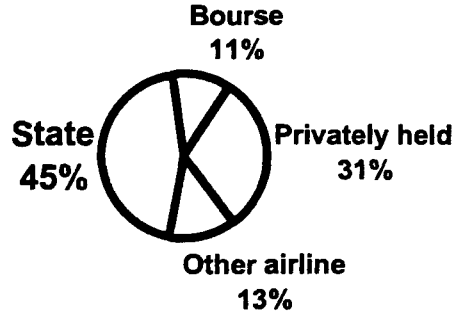
A government's cost of financing will depend on:

- the willingness (or obligation!) of taxpayers to provide interest-free financing
- the interest rate on public debt.

The latter will be determined by investors' assessment of the state's creditworthiness, often based on work by rating agencies such as Moody's Investor Service, Fitch, and Standard and Poor's.

The notion that aircraft investment is state-funded is of course heresy in the current view of airlines as generators of economic wealth. Financiers correctly point out that the relatively low cost of government financing can encourage dramatic over-investment, when the airline is competing against profit-oriented airlines in the international arena. However, the fact of the matter is that a huge amount of airline equity remains in the hands of governments around the world. The following graph shows that among the world's alliance members , the state is the largest shareholder in 45% of the airlines surveyed by Airline Business.

Airline ownership: Largest shareholder in the airline



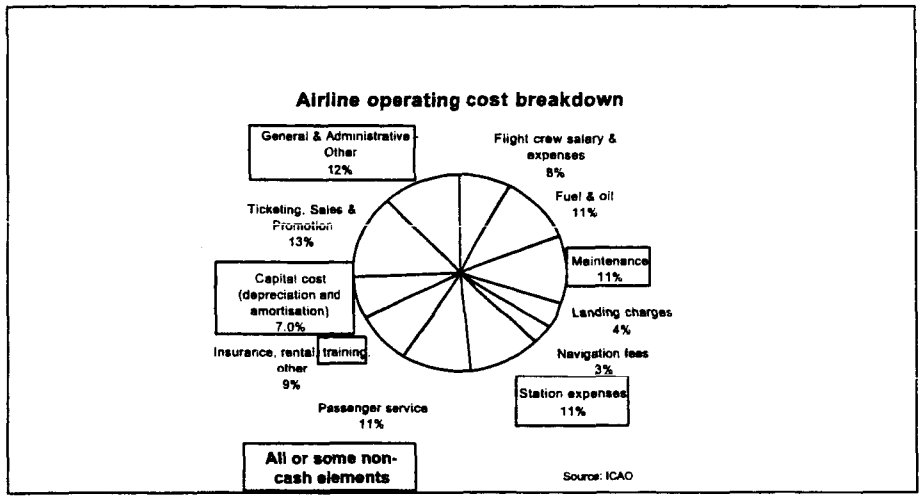
Source: Airline Business Alliance Survey, 2001, 163 Alliance members surveyed

On the other hand, most of the world's airlines today seek to make increased use of capital market financing. The wave of privatisation is reaching into every part of the globe. China Eastern and China Southern in Asia, and ACES and LAN Chile in South America are just a few examples of airlines partially or fully privatised in the last 20 years. The most dramatic wave of privatisation has been in Western Europe, where Air France, British Airways, Iberia and Lufthansa have raised large amounts of private equity, Of these four leading companies, only Air France remains majority state-owned. In addition, start-up airlines are finding private capital where no state funds are available. Notable examples are India's Sahara and Jet, not to mention such roaring newcomers as easyJet and Ryanair in Europe, and JetBlue in the United States.

This unmistakable trend toward the use of private capital points up clearly the need for financial valuation of the companies, as well as a solid and transparent financial justification for the large investments needed to support growth and profitability in the future.

Investment valuation tools for airlines

Analysts and academics agree that cash-based measures provide the soundest indicator of investment viability, if for no other reason than the fact that investors are putting up cash, and demand a cash return from the project. That said, the fundamental tool used to compare aircraft in terms of economic performance remains Direct Operating Cost (DOC), which reflects a P&L approach, including non-cash items such as aircraft depreciation.



Airlines and aircraft manufacturers use absolute and relative DOC figures to compare aircraft in economic terms. While extremely useful for comparing the characteristics of today's aircraft, DOC must be complemented by time-sensitive measures of economic viability for managers:

- it is a static measure, ignoring the risky evolution of economic conditions as well as the time value of money.
- it combines cash and non-cash items, making valuation difficult
- it assumes that the aircraft investment is fixed from order to retirement of the aircraft, ignoring the flexibility offered by conversion options and operating leases
- it places the emphasis on cost rather than focussing on the revenue-generating potential of a given unit (seat-kilometre or trip)

Using NPV for investment valuation

To correctly value a long-term investment, firms must first estimate cash flows in three clearly defined categories, consistent with cash-flow statements and corporate finance theory.

The three commonly accepted cash-flow categories are

- **Operating** cash flows arising from the use of the equipment
- **Investing** cash flows, the purchase and eventual disposal of the equipment
- **Financing** cash flows directly related to acquiring the equipment

The publication of cash-flow statements in this format by airlines is relatively recent. For

example, British Airways first began publishing a complete cash-flow statement in the mid-nineties, but by now, analysts are familiar with these categories.

The financial theory taught in business schools and presented in corporate finance texts requires that the Operating and Investing cash flows be discounted at the company's overall cost of financing - usually defined as the Weighted-Average Cost of Capital (WACC) - to calculate the Net Present Value (NPV).

The financing cash-flows must be left out of the discount calculation for very good reasons:

- WACC already includes a charge to the project for the debt financing
- discounting financing cash flows at WACC would incorrectly show value creation by borrowing at the lower debt rate and "lending" the proceeds to the project at the higher WACC rate
- management is forced to focus on the investment and operation, rather than the way the aircraft are financed

This method, widely taught and at least partially understood in industry, poses serious problems for analysis of aircraft investments where increasingly, there are critical interactions between investment and financing decisions.

Practical Problem 1: Estimating the cost of capital (WACC)

WACC is as its name suggests, the average cost of debt and equity capital financing, weighted by the relative market values of debt and equity in the firm's target capital structure.

The cost of debt is more or less transparent thanks to the financial press. For private carriers, credit ratings or shadow ratings and information published in financial journals provide at least rough guidelines to borrowing costs. For state-owned airlines, the government borrowing rate plus a margin for the specific credit risk of the airline can be used as a proxy.

Cost of equity is another matter. Many state-owned airlines are simply unaware that there is a cost to equity, considering that their "company" is a public service, funded by tax revenue and general government borrowing. Closely held private airlines also demonstrate a lack of transparency regarding the cost of equity, though presumably the airline's management is quite well aware of the returns their shareholders expect.

Even in more mature markets such as Western Europe, Japan and the U.S., estimating cost of equity is difficult. Turner and Morrell (2002) clearly show that estimates of systematic risk and cost of equity vary among different sources, and in any case are volatile over time.

Practical Problem 2: operating lease vs. purchase analysis

Lease rentals include a charge for the aircraft depreciation, another reflecting the cost of financing the aircraft, and a profit margin for the lessor. If the rentals are *included* in the cash flow the rule of leaving out financing flows if violated, and if they are *excluded* the cost of the aircraft is ignored.

This problem complicates the necessary task of comparing leasing with purchasing. While there are many theoretical discussions of lease valuation, these are too often bound up with complex tax formulations and couched in language practitioners don't understand. There are surprisingly few practical solutions proposed by the literature.

Practical Problem 3: Pre-tax vs. after-tax analysis

Copeland et al. (2000) compare pre-tax and after-tax analysis, and conclude that "it is virtually impossible to perform a real-world discounted cash-flow analysis using the pre-tax approach." In leasing vs. purchasing analysis, tax considerations can be very important

After-tax analysis can be somewhat complex, due to the diversity and ambiguity of tax codes, and the fact that tax is often based on accrual accounting rather than cash-flow. In practice, financial managers often require that analysis be done pre-tax.

One notable effect is to *increase the project discount rate*, providing a practical sort of financial cushion against the risks of the project. The increase is due to the tax-deductibility of interest payments: the after-tax borrowing cost is the pre-tax interest rate times (1-Tc), where Tc is the effective tax rate on corporate profits.

Practical Problem 4: Bottom-line returns to investors

Airline management justifiably wants to know the net cash flows that will accrue to the shareholders, including the leverage benefits offered by debt financing. There is a strong tendency to discount ALL the cash flows.

Financial theoreticians have resisted this approach, ever since the classic Modigliani and Miller Propositions I & II, which postulate that returns on investments in companies are independent of the way the firm is financed, since shareholders can duplicate any debt financing for themselves. Proposition II softens this stance by recognising the benefit of interest tax deductions, but the bias against including financing cash-flow remains. Thus, classic NPV analysis ignores this measure, but in practice, the investment modelling done for project finance provides some insight.

Practical Problem 5: Dealing with uncertainty in the cash flows

This is the greatest problem of all, starkly illustrated by many airlines' current struggle to maintain profitability and cash reserves in the face of a dramatic downturn in air traffic following the terrorist attacks on New York and Washington, the subsequent wars in Afghanistan and Iraq, and most recently, the SARS epidemic. The current situation is the most dramatic example of the shocks – such as the Gulf War - and cyclical downturns – such as the 1970's oil shocks - that periodically turn the airline world upside-down.

A common "solution" is to artificially raise the discount rate to compensate for the risks of the project. This is modelling equivalent of attempting to "insure away the problem." It begs the question of the key management responsibility to manage risk, and ignores the potential upside if market conditions are good.

In the rest of this paper, we will propose a comprehensive set of solutions to problems 2 & 4, and especially this critical problem of uncertainty in investment analysis, both within the NPV framework, and using Real Options valuation.

Solutions within the NPV Framework

To clearly and comprehensively approach these issues, it is critical to have a sharp understanding of the elements under analysis. On the financial side, managers must estimate cost of debt and cost of equity using the tools available, however imperfect they may be.

Second, it is critical to clearly distinguish between, operating, investing, and financing cash flows. Recent advances in financial reporting requirements (yes, there have been some advances!) help to clarify these distinctions. Once a company has clarified these definitions, a comprehensive approach is possible.

Finally, it is important to see that the results are significant! In this section we will discuss the alternative methods proposed, and provide a mathematical example of the results. Throughout the paper, we will be looking at operating an A320 family aircraft over a densely travelled 600 nm sector. Revenue and costs used are those costs typically encountered in the European travel environment, which couples a dense and competitive transport network with high operating costs, notably labour and navigation/landing/ handling fees. The example is stylised, and not intended to represent any particular aircraft operation.

Estimating the cost of capital

If we look broadly at the global airline industry, airlines in Europe, the U.S., Japan, with their extensive access to stock market financing, are the exception rather than the rule. Their listed shares provide highly transparent historic returns, which can be used to estimate cost of equity with the Capital Asset Pricing Model (CAPM) or other techniques.

An excellent recent example of financial transparency and discipline in applying the concepts to airlines is Lufthansa. The airline has published its estimated WACC, which is used to complement the traditional DOC analysis, which of course it continues to perform in evaluating aircraft.

Value-oriented management of the business segments
Basis for calculating the cost of capital

	2001
Risk-free interest rate	5.1%
Market risk premium	5.7%
Beta factor	1.05
→ Cost of equity after taxes	11.1%
Cost of debt	6.3%
Equity share (market value, target capital structure)	55.0%
Debt share (target capital structure)	45.0%
→ WACC after taxes	8.9%

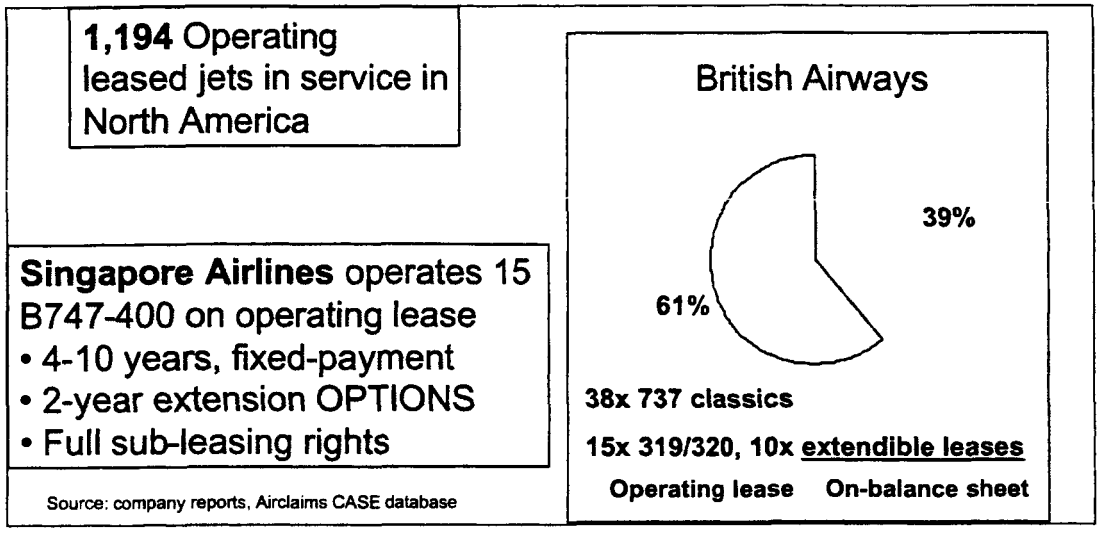
Source: Lufthansa Annual report, 2001

Because of the volatility of both borrowing and equity costs, there is a strong temptation to compensate for risk by artificially increasing the discount rate used in the analysis, thus making the project more difficult to justify. This approach has the serious disadvantage of "funnelling" all the risk through the discount rate, and also reduces the value of the analysis itself: a fundamental task of management is to deal with risk effectively rather than "insuring it away" by using an artificially high cost of capital.

We suggest that a better approach to uncertainty is use a moderate cost of capital, either using market measures such as Lufthansa has done, or alternatively, using broad, long-term regional benchmarks such as those identified in Dimson, Marsh and Staunton (2002). We then can capture cash-flow volatility using Monte Carlo simulation, calculate *Expected* NPV and the probability of success, and extend the investment analysis using

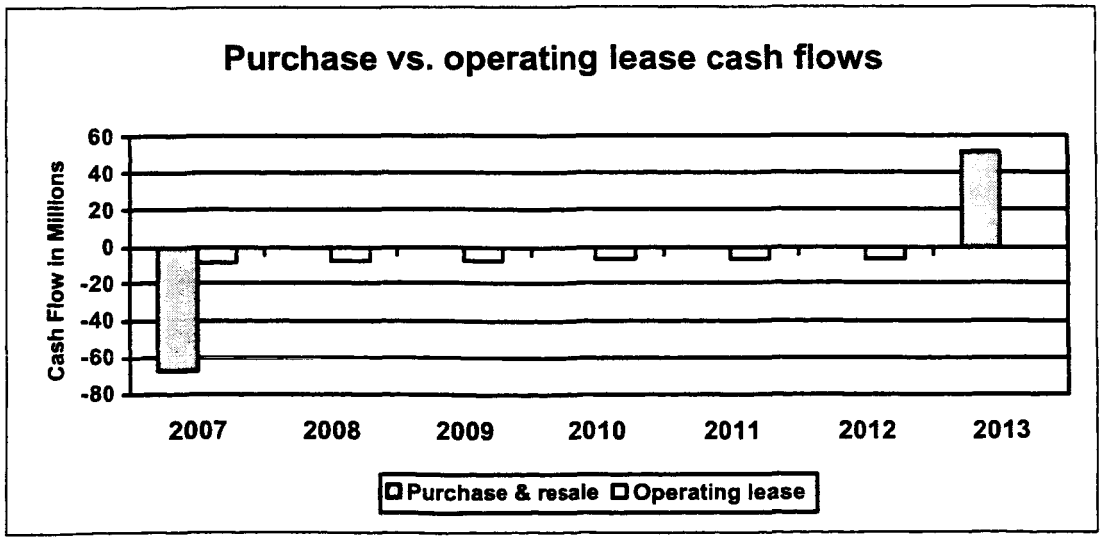
Operating lease vs. Purchase analysis

Operating leasing has undeniable benefits for operators of aircraft, offering a level of fleet flexibility and residual value risk reduction unobtainable when purchasing. Growing far beyond their origins as a "cheap" – or more accurately, low cash-out - solution to aircraft finance, operating leases are the financing vehicle of choice for around one quarter of all new large civil aircraft delivered today, extensively used today by the world's largest airlines. Companies use operating leases for flexibility, when adopting a new aircraft type, or as part of an aircraft type exit strategy, as shown below..



A correct discounted cash flow (DCF or NPV) analysis of leasing vs. purchasing should at lease estimate and include the COST of the flexibility benefits, when compared to debt financing. The classic pitfall in NPV is including and comparing the operating lease cash flows, and comparing the result against the purchase cash flows. This problem is discussed from a theoretical standpoint in Myers (1974), Myers, Dill, Bautista (1976), Copeland and Weston (1982), and applied to aviation in Stonier (1998).

Viewed graphically, the differences are apparent.



When the cash flows are discounted at the WACC, the result is inevitably favourable to leasing, and places undue emphasis on residual values.

This is conceptually incorrect for two reasons:

- The cost of purchasing or leasing an aircraft should be compared to the benefits of operating the aircraft, not to one another
- Lease payments include both investing and financing cash flows, as well as a risk premium for the lessor.

Leasing is fundamentally a financing vehicle, and should be compared with the costs of borrowing or taking on a finance lease (also known as a capital lease).

To correctly estimate the cost of leasing, we recommend using a variant of the well-documented Adjusted Present Value concept. Under APV, cash flows of different risk classes are discounted at the discount rates that reflect the risk class of the cash flows. This method is discussed from a theoretical standpoint in Myers (1974), Myers, Dill, Bautista (1976), Copeland and Weston (1982), Copeland et al., 2000. Our experience suggests that it has yet to be fully understood and adopted in industry practice.

Implementing the method is straightforward, as summarised in the following table.

Discount rate	Purchase scenario	Operating lease scenario
Cost of debt	Financing cash flows: loan/finance lease advances and repayments of interest and principle	Leasing cash flows
Cost of equity	Operating cash flows Purchase and re-sale of the aircraft	Operating cash flows

This approach has two major advantages:

- clarifying that the risks of owning & operating aircraft are borne by the equity investors
- directly comparing the financing alternatives, and showing the cost of the flexibility inherent in leasing

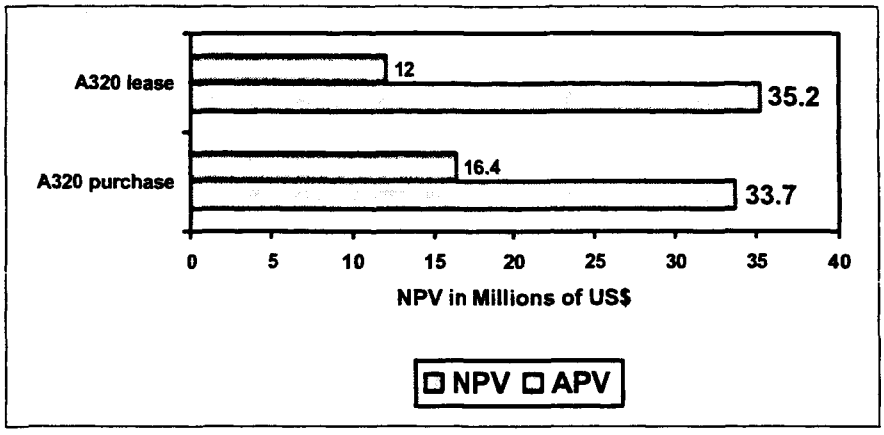
This is a major step beyond classic APV, where only the tax deductions on interest payments are discounted at the cost of debt, capturing leverage benefits. We suggest that just as WACC has been thoroughly accepted in spite of its theoretical pitfalls and the difficulty in estimating cost of equity, this variant of APV should be examined and adopted to compare leasing versus purchasing in an NPV framework.

When it comes time to finance deliveries, aircraft finance specialists recommend that operators discount the term sheets offered by different financiers to determine the best offer. Our approach to investment analysis using APV simply extends this tactical approach to long-term strategic investment analysis.

A final practical problem in comparing leasing and purchasing concerns the investment horizon. Operating leases are generally less than ten years in length, and are often three, five, or seven years, with or without options to extend. To properly compare leasing and purchasing over a longer term, it is necessary to assume that a lease is renewed

over the investment horizons. Methods used to re-price the lease after the primary period range from simply assuming that the lease rate will remain fixed, to modelling the variation in lease rates as a function of aircraft values.

As the graph below illustrates, the differences in valuation are clearly significant. First, APV results in a lower overall evaluation because the operating cash flows are discounted using the higher equity rate. Second, the purchase scenario APV is $2.4m higher than operating lease, reflecting the cost of the residual value risk transfer to the lessor.



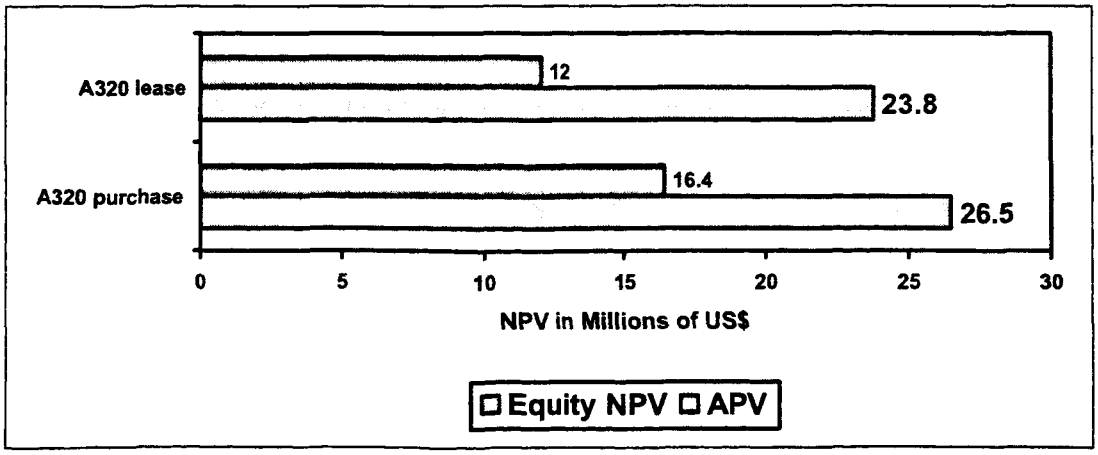
Bottom-line returns to investors

In the classic theoretical and management literature, the investment and financing decisions are kept strictly separate. On the other hand, airline stakeholders need to understand the overall costs and benefits of investing.

For this purpose, the Equity NPV concept commonly used in project finance builds on the notion of clearly distinguishing the cost of debt, and the cost of equity. All project cash flows – investing, operating, and financing – are discounted at the cost of equity.

The resulting value shows the result of the investment from the shareholders' point of view, including the leverage benefits from debt financing, and obviating the distinction between leasing and purchasing.

Since tax is a very important consideration for investors, this analysis requires an after-tax approach. As with APV, the differences in valuation are substantial, and the underlying assumptions and implications need to be clearly understood by managers.



Comparing the methods

Each method answers a different, critical question.

- *NPV* measures the fundamental return on the investment, assuming the project is financed using the firm's overall capital resources at a target debt and equity mix.
- *APV* clearly separates cash flows into different risk classes, and measures the cost of residual value risk transfer to the operating lessor.
- *Equity NPV* shows the bottom-line returns to the investors, including the leverage benefits of the financing.

Investment Planning and Uncertainty

Now we come to the greatest challenge for airlines today, which can make the difference between success, and failure: dealing with unexpected shocks in the environment, large or small. Two of the most prominent trends over the last 15 years in aircraft investment planning have been reductions in manufacture lead-times which increase airline flexibility to convert from one aircraft type to another before delivery, and the increased use of operating leasing by airlines of all sizes and locations.

Both innovations help airlines cope with the uncertainties they face in operating aircraft. Financial theory provides new means to value these benefits, which can then be incorporated directly into the cost of the financing overall on a strategic basis, rather than deal-by-deal or delivery-by-delivery.

As we have seen, simple NPV analysis fails to take into account both the highly uncertain economic environment airlines face, and the flexibility offered by conversion options and operating leasing. The APV concept discussed above is really a measure of the *cost* of leasing – and hence the transfer of value to the lessor – rather than an estimate of the flexibility benefits to the operator of the aircraft.

We propose two complementary approaches that take advantage of the potential flexibility of the NPV approach to better understand investment dynamics on the one hand, and the application of Real Options Analysis (ROA) to better understand the value of flexibility to aircraft operators on the other.

Dealing with uncertainty in the cash flows: the Expected NPV concept

As we have seen, the NPV methodology can be adapted to address many difficult questions in airline investment planning. It is well documented and widely taught, and has the advantage of being relatively easy to explain and intuitive. On the other hand, practitioners suffer from a tendency to inflate the discount rate artificially, to "insure" against risk. We propose to capture the risk of airline cash flows in a different way, by extending the concept to an *Expected NP"*, similar to the familiar statistical concept of Expected Value, where outcomes are weighted by probabilities.

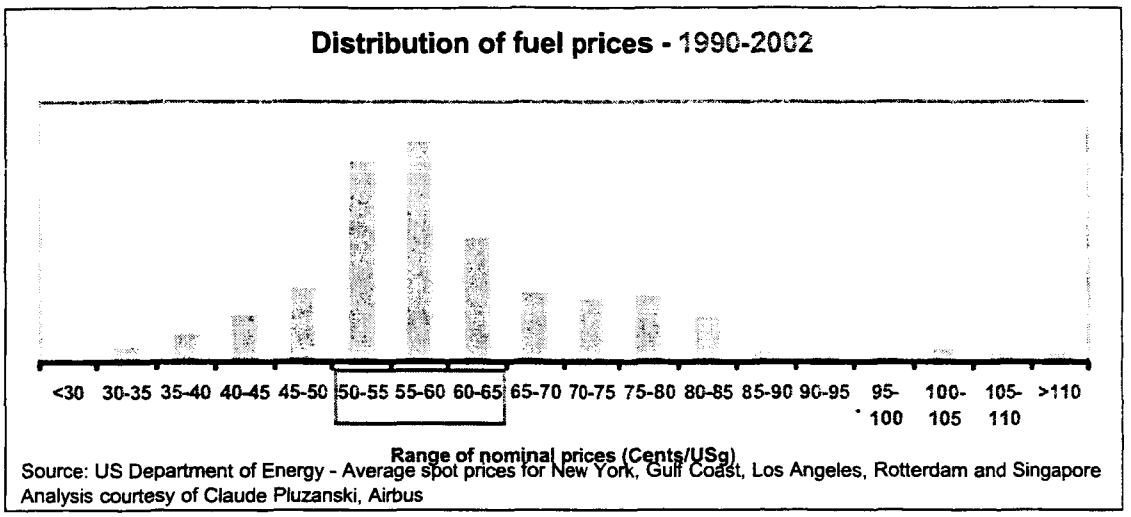
To do this we use Monte Carlo analysis, a well-proven statistical technique which has earned a key place in airline investment planning.

The Monte Carlo simulation is built on a cash flow model, which calculates NPV. Uncertainties in the operating environment are estimated using probability distributions. Good examples in aviation include fuel prices, traffic growth & yields, and cash operating costs. These estimates may be derived from historical data, management judgement, or a combination of the two.

The NPV model is then run hundreds or thousands of times. For each trial, a discrete value is assigned to each input variable according to the assigned probability distribution. An outcome (NPV) is generated, and added to the data set.

The output of the analysis is a range of possible NPVs, including an *Expected NPV* (the mean outcome). In addition, standard measures of dispersion around the mean are calculated. A probability of a positive NPV can then be readily calculated, changing the focus of the analysis and management discussion.

Taking a very well known – and volatile – example from aviation, the histogram below shows the pattern of fuel prices in the 1990s.



Source: US Department of Energy - Average spot prices for New York, Gulf Coast, Los Angeles, Rotterdam and Singapore
Analysis courtesy of Claude Pluzanski, Airbus

In classic NPV, we assume that input prices will be reliably predictable, which is more comfortable. In *Expected NPV*, we recognise that there is significant uncertainty in prediction.

There are at least two major benefits to using Monte Carlo analysis to complement DCF in investment analysis:

- It forces management to estimate and manage input risks, rather than insure them away.
- One of the key outputs is an estimate of the probability of success, given the results of the trials

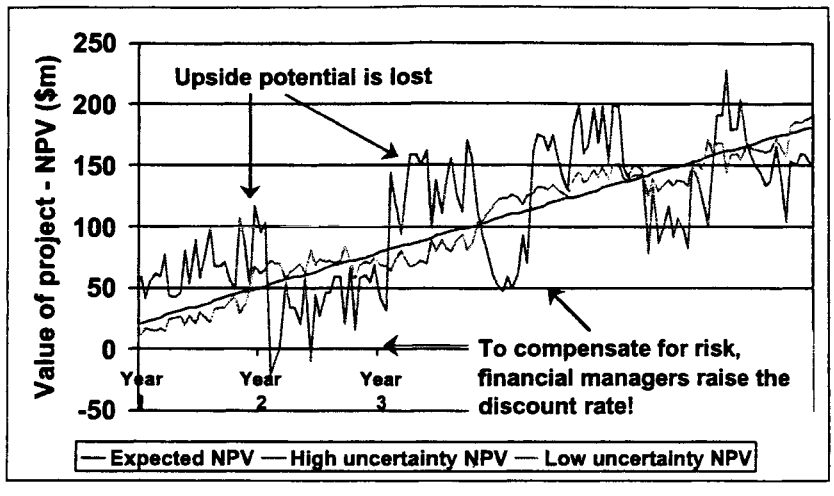
Not surprisingly, these benefits create corollary challenges: management is indeed directly confronted with the need to quantify and manage uncertainty, and to accept that the decision to invest is made knowing that there is a readily calculable uncertainty of success.

This is particularly uncomfortable for management cultures that do not readily accept uncertainty. In fact, the framework of analysis is shifted to a risk management approach, which is inherently less comfortable than the "yes-or-no" outcome of NPV analysis.

Using Real Options to value flexibility

Clearly, the NPV approach to investment planning is useful as part of the analysis, but in many ways it fails to value the flexibility offered by lessors and manufacturers, and by extension, the cost of giving up flexibility when using constraining financing or ownership structures such as leveraged leases (tax leases).

As we have seen, one common practice in using NPV is to raise the discount rate in order to compensate for risk. The effect of this is illustrated in the following graph.



NPV taken alone will incorrectly estimate value creation in a volatile environment, which can be misleading on the upside as well as the downside. Real Options Analysis (ROA) builds on *Expected NPV*, providing new insights into the value of flexibility: APV measures the financial *cost* of flexibility, whereas Real Options measures the *value* of flexibility in investment planning.

Review of real options methodology

Options pricing theory was introduced by Fischer Black and Myron Scholes in 1973, and has been used since then to price financial options on shares, commodities, currencies, and interest rates. Real Options applies this basic framework to the pricing of options on real assets, such as aircraft. These can be Call options such as purchase options and aircraft family conversion options, or Put options such as extendible operating leases or residual value guarantees.

Options pricing is a curious blend of intuitively correct - even obvious - value drivers, rather abstruse mathematics, and very large assumptions about the similitude of real assets and financial assets.

Fundamentally, the value of an option *increases* with

- volatility in the economic cycle and demand for air transport
- uncertainty in competitor responses
- variability in input prices: fuel, labour, financing...
- time to expiry of the option, eg., delivery of the aircraft or end of the extendible lease
- the interest cost of borrowing

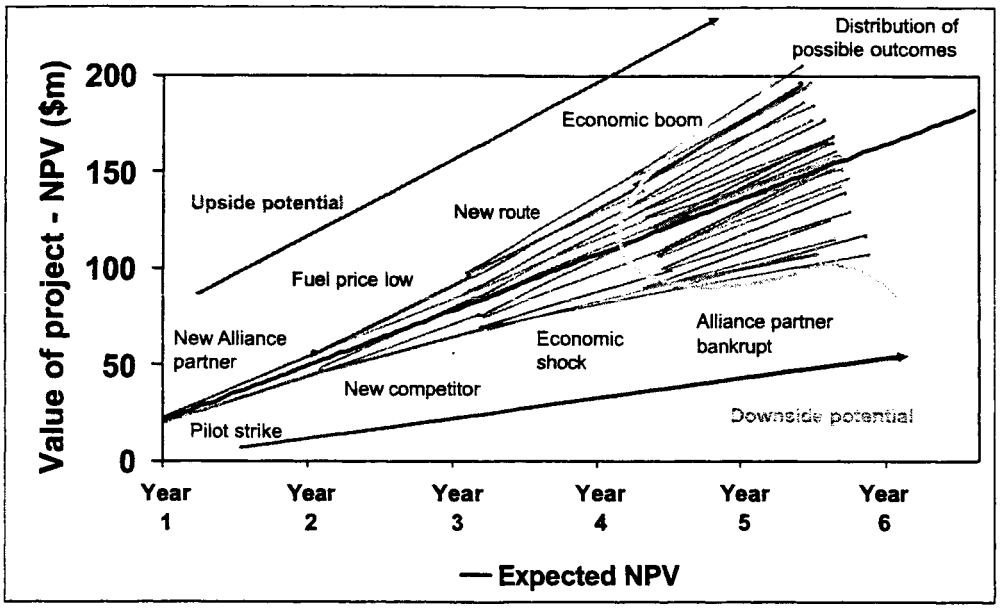
and *decreases* with...

- the price of the option
- the implementation cost of exercising the option

The theory and practice of real options valuation is extensively discussed in Copeland (2001), Mun (2002). Stonier (1999, 2001) goes the furthest in applying the concept to aircraft option valuation.

The basic methodological tool is the binomial lattice, which builds a set of potential outcomes to the project using the output from our *Expected NPV* under Monte Carlo. Key inputs to build the lattice are the standard deviation of returns given uncertainty, and the number of "steps" or branches in the binomial lattice. Hence, Real Options can be viewed as an extension and improvement on *Expected NPV*, itself a great advance beyond simple, deterministic NPV.

The binomial lattice is a convenient way to represent the uncertainty present in a dynamic market like air transport, as the graphic below demonstrates. Around the straight line Expected NPV, upside and downside potential are present in this more realistic view of the potential for value creation.



Notwithstanding certain methodological barriers, Real Options provides insight into the costs and value of intangibles like aircraft family conversion options, and operating leases. It is a method that quantifies and prices the intuitive advantages of "looking before you leap."

Using ROA to value an aircraft family conversion option

To demonstrate the technique, we will use the example of a family conversion option, known in the options jargon as a "switching option." Manufacturers of aircraft offer airlines the possibility to convert between members of an aircraft family before delivery,

given a firm order. In our example we will value the option to switch from and A320 with 150 seats, to an A321 with 175 seats.

Intuitively, we realise that the A321 investment acquires value if airline traffic and yield conditions are favourable. Since these two variables are highly unpredictable, options pricing takes us beyond the intuition to the understanding that the option to choose *itself* has considerable value for airlines, whether traffic and yields increase *or* decrease.

To value the option, we set up a cash-flow model, with one scenario for the A320, and another for the A321. Each aircraft has its particular capacity for passengers and cargo, and its trip cost structure as a basic input. In the model, we simulate the operating environment: traffic demand, spill factor, revenue yields, and fuel costs are among the key inputs.

Next, we associate probability distributions with the key uncertain inputs to the model. In our stylised example, we will simulate uncertainty in basic demand for seats, and fuel prices. Seat demand is set using a most likely demand for 150 seats, with downside potential of demand for only 110 and upside up to165: zero overall traffic growth is assumed in our simplified example. Fuel price uncertainty is simulated using the historical analysis presented above.

Running the Monte Carlo simulation, we discover that the A320 returns carry (for example) a 6% standard deviation, and A321 returns carry a 7% standard deviation. This is intuitively correct, since a larger shell size will carry more upside potential, but more risk as well.

The standard deviations are used to build a binomial lattice of possible NPVs. At each node of the lattice, the model compares the NPV of acquiring and operating the A320 with that of the A321. If we choose to exercise the A321 option, an assumed switching cost of $500,000 is incurred for spares, training and other Entry into Service (EIS) costs for the new type. The NPV of the A321 must therefore exceed the A320 NPV by more than this $.5m cost, or we will stay with our original order of the A320. In our five-step example with sigmas of 6%/7%, the lattice of decisions based on our assumptions is represented below.

A320	**A321**	**A321**	**A321**	**A321**	**A321**
	A320	**A320**	**A321**	**A321**	**A321**
		A320	**A320**	**A320**	**A321**
			A320	**A320**	**A320**
				A320	**A320**
					A320

In nine of the simulated potential states of nature in which conditions in the air transport market are relatively good, we will exercise the option to convert to the A321. If conditions are consistently bad over the period the option remains open, there are 12 outcomes under which we will stay with the A320.

To value the option at contract signature, we must reason *backward* from the deadline to exercise the option in the future, to today. At deadline, we will maximise our benefit (NPV) by choosing the A320 or the A321. At each *preceding* node in the lattice, we will either exercise the option to convert to the A321, or we will keep the option open. The option value at each node as we move backward to today is thus the maximum of the A321 NPV less the switching cost and the expected value of the subsequent nodes, discounted back at the risk-free rate to compensate for the time value of money.

The value of the flexibility during the option period (the option price) is the single value at the root of the lattice, minus the NPV that we expect from the aircraft. In our example, the value is nearly $125,000. This is a measure of the value inherent in flexibility offered to the airline, consistent with valuation methods used throughout the world, and built on well-established statistical and mathematical theory.

Methodological challenges of Expected NPV and Real Options Analysis

Mean reversion and autocorrelations in cash flows can create erroneous results in both Expected NPV and ROA valuations. In a cyclical industry, many inputs tend to correct themselves over the cycle, reverting to a long-term trend or average. Mean reversion in aviation markets is discussed in Stonier (1999). Further, there may be correlations between the behaviour of input variables. A notable example is the relationship between aircraft market values and operating lease rates. The validity of postulating correlations between input variables needs to be further examined, and clear limits determined.

Estimating the project volatility is another question mark for practitioners. In one method, managers are asked to accept the postulate that real asset values can be approximated by comparing them with listed firms, a rather tenuous proposition, and it is unusable in less open securities markets, where share prices are not readily available. In another, the volatility of projects with significant negative cash flows in extended periods cannot be calculated accurately, due to the impossibility of calculating a natural logarithm of a negative number. Five potential methods are dissected in Mun (2002). We use the logarithmic present value approach in our modelling, and have found no significant practical difficulties.

Both NPV and ROA are subject to the assumption of a *constant discount rate throughout the project.* Turner and Morrell (2002) and others have pointed out that discount rate estimates are variable, and clearly, companies' costs of capital vary over time. This is an excellent example of volatility in the market, and yet, the value is left constant in NPV. In ROA, a constant rate is used to calculate project volatility in the logarithmic present value method. No completely satisfactory solution to this problem is available.

Time vs. steps in the binomial lattice is another practical challenge. The outcome of the lattice is a set of states of nature, all expressed in NPV. The number of terminal nodes in the lattice depends on the number of steps used in the analysis, which is not the same as the time to expiry of the option. On the other hand, the nodes of the lattice are discounted back to determine the option value, implying that the potential NPVs become known in the future. Understanding the relationship between the steps and nodes on the one hand, and the time and decision points between contract and expiry on the other, is rather arduous for practitioners. Unlike the fundamental options value drivers, it is not at all intuitive.

Financial evaluation is an important part of airline fleet planning, but it is just one part of a very complex strategic process. Airline managers do not have infinite time to dedicate to learning how to value options. Mastery of the *advanced stochastic methods* used is rare enough outside Operations Research departments of universities. Additionally, the ability to explain the concepts in an efficient, intuitive way is not given to all the mathematical experts. We believe that this "knowledge gap," between expertise and explanatory ability needs to be closed, through co-operative research between learning institutions and airlines.

There are large imperfections in any valuation method, but we suggest that in managing large risks in investment decisions, an imperfect answer to management and shareholders is better than no answer.

Conclusion

We propose in this paper the notion that the NPV technique offers the potential for flexibility beyond its classic interpretation. Our proposed extension of Adjusted Present Value (APV) provides insight into lease vs. purchase decisions unavailable through classic NPV analysis. Equity NPV demonstrates the overall returns of the project from a shareholder perspective.

In order to benefit from these techniques, managers need very clear definitions of the elements of analysis – costs of debt and equity, cash-flow categories – in order to exploit the potential of the method.

APV is very useful in today's environment, as it measures the *cost* of flexibility in a concrete and consistent way. Real Options Analysis complements this analysis, by measuring the potential *value* of options. Practitioner can reason in terms of uncertain outcomes, in addition to measuring financial costs, yielding a complete picture of the investment dynamics.

The methods – in particular ROA - require further research & elucidation before they will be widely applied in practice. Financial theoreticians must also keep in mind that financial evaluation is only part of the extraordinarily complex evaluation of today's aircraft by airlines around the world.

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